

I.T. CARLOW, SCHOOL OF SCIENCE AND ENGINEERING

Tradesmen.ie

Research Manual

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11/16/2010

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Introduction

This research manual describes the project I am about to begin. It provides an overview of the existing application that will need to be redesigned to some extent, a new ranking algorithm that will need to be developed and a mobile application that will also need to be developed.

The goal of this project is to redesign the main functionality of the web site described below, namely, registration process for both clients and tradesmen, bid placing process and bids browsing functionality and to upgrade the code base from older classical ASP technology to a new platform that will be chosen during my research.

The second goal of this project is to design a safe and fair ranking algorithm that will be able to sort bids made by tradesmen for a given job in such order that only the tradesmen fit for the job will be given the opportunity for complete the job in question.

And the final goal is to develop a cross platform mobile application that will enable tradesmen and clients to use the functionality provided by the main web site on their smart phones such as iPhone and Android.

Tradesmen.ie – Existing application

Tradesmen.ie is a free online service for customers looking for a tradesman helping them get up to 4 quotes for their job. The customer fills in a form online describing the work that they want carried out and the type of tradesman they are looking for. The service then sends text messages and/or emails to all of the tradesmen who have expressed an interest in work in that area. The first 4 tradesmen who reply are sent the customer contact details and get a chance to quote for the job. (1) (See figure 1).

On the other hand, tradesmen need to create an account on the system to start participating (see figure 2). Before the account is made active, the system sends out a text message with verification code that the tradesman is required to enter on the web site to activate the account and verify the correctness of the mobile number.

The final step of registration is a request for references from three previous customers (see figure 3). The tradesman enters details for three previous customers, their mobile numbers and submits the request. Once the request is validated by the web site administrators, reference requests are sent out by a text message to clients. In order to leave the feedback, clients simply reply to the text message with the wording of the reference.

Once the registration process is completed, the tradesman can start placing bids on jobs. S/he can browse through the list of current jobs and view specific information about each of the jobs like budget, location, date created and the job id. If a tradesman wishes to bid on a particular job, s/he would need to send a text message to a special number with the job id followed by their bid amount. The bid amount that I refer to here is not the actual price for the job, but rather how much the tradesman is willing to pay to get the clients order, or in this case the contact details of the client. When the bidding time is over, the system picks top 4 bidders and sells the lead to them for the price of the lowest bid from those top 4. When the sale is over the system provides each of the tradesmen with the client's contact details. From that point, the system no longer interferes in the process and tradesmen communicate to the client in private, provide their job quotes and try to win the job.



[Main Menu](#)
[Home](#)
[Get quotes for your Job](#)
[Register as a tradesman](#)
[Browse Jobs](#)
[Links](#)
[About us](#)
[Blog](#)
[Contact us / FAQs](#)
What people said about Tradesmen.ie
 "Excellent service second time using it. Love the way you can see the feedback on previous jobs."
Eavan Clancy
Celbridge, Kildare
[<< Last](#) | [Next >>](#)

Required ...Killiney,Dublin County South **16 November 2010 - Roofer Required** Loose tiles on roof,

Looking for a tradesman?

Well you've come to the right place! To receive up to 4 quotes from rated tradesmen all you need to do is fill in the simple form which asks you to describe the type of job you need to do and what type of tradesmen you are looking for. We then contact and inform the tradesmen in our database who are available and who are willing to quote for your job. The tradesmen benefit by getting an opportunity to grow their business and you benefit by getting up to 4 quotes for your job.

Required fields are marked with a red asterisk*

First Name*
 Second Name*
 Email*
 Retype Email*
 Address*
 Town*
 County*
 Phone*
 Mobile*
 Retype Mobile*

When is the best time to phone? For example can we phone you anytime or would you prefer only to be contacted at certain times? Please let us know.

Job Name (e.g. Build Extension)*
 Has Planning Permission been applied for? (If this is not a building job the answer will usually be 'Planning not required')

When do you wish to proceed? It's very important to answer this question accurately so the tradesmen can see if the job suits.

Tradesman Required *

Description of job (the more detailed the description of the job the better chance the tradesman has of quoting for it)

What is your budget? (Be as accurate as you can to get a better response) *

where did you hear about us?
 Yes No

I agree to the [User Agreement](#) and [Privacy Policy](#)
 I would like receive the monthly newsletter and enter the prize draw for up to €80 each month (we will not share your information with anyone else) Yes No

If you have a promotion code enter it here

Our aim is to get up to 4 tradesmen back to you within an hour of posting the job during working hours. If we don't get someone back to you within the hour, we will definitely try to get someone to call you by the next working day. If you have any questions or feedback please phone or email us on our [contact page](#), we are always delighted to hear your feedback.

Figure 1. New Job Creation Screen.



- ▶ Main Menu
- Home
- Get quotes for your Job
- Register as a tradesman
- Browse Jobs
- Links
- About us
- Blog
- Contact us / FAQs

 What people said about [Tradesmen.ie](#)

"Great service & great tradesman - would use both again."

Linda Murphy
Clondalkin, Dublin 22

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16 November 2010 - Plumber Required ...,Bray,Wicklow 16 November

Register as a tradesman

If you are a tradesman and you are interested in generating new business, this is the solution for you. All you need to do is fill in the form below to begin receiving notifications about people who are looking for work done in your area. You must be a qualified tradesman or a registered business with an Irish or European recognised qualification. Required fields are marked with a red asterisk*

First Name*
 Second Name*
 Company Name (if applicable)
 Email*
 Retype Email*
 Address*
 Town*
 County*
 Phone*
 Fax
 Mobile*
 Retype Mobile*
 My Tradesmen Categories is/are:
 (To select more than one item, hold the CTRL key on your keyboard while you click on each item.)
 Alarms - Security & Fire
 Architect
 Appliance Repairs
 BER Assessor
 Block layer
 Brick layer
 If your tradesman category is not listed above please add your category here and we will add it.
 Counties where I work are:
 (To select more than one item, hold the CTRL key on your keyboard while you click on each item.)
 Antrim
 Armagh
 Carlow
 Cavan
 Clare
 Cork
 Write a brief description of what type of work that you do
 Rate per hour that you charge (this can be useful to give the customer a rough idea) **Only enter numbers here**, no letters or euro symbols. euro/hour
 Rate per day that you charge (same as above) **Only enter numbers here**, no letters or euro symbols. euro/day
 Any other rates e.g. price per block, per tile, per slab, per sq ft, per linear metre
 Minimum job value that we should notify you about No Minimum
 Maximum job value that we should notify you about No Maximum
 I would like to receive leads by Email Text Message
 I agree to the [User Agreement](#) and [Privacy Policy](#)
 if you were referred by a tradesman you can put his/her name here
 where did you hear about us? Choose

Figure 2. Tradesman registration screen.



► Main Menu

- Home
- Get quotes for your Job
- Register as a tradesman
- Browse Jobs
- Links
- About us
- Blog
- Contact us / FAQs

What people said about 

"I already have recommended Tradesmen.ie and will continue to do so."

Teresa McCarthy
Dublin, Co. Dublin

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Thank You

In order to improve your chances when quoting for a job you can request up to 3 of your previous clients to send us a text message with a reference for your work. It is advised that you contact your clients first and ask their permission to send this text. You can see a sample of the text that will be sent below

Mobile1 <input type="text"/>	Mobile2 <input type="text"/>	Mobile3 <input type="text"/>
First Name 1 <input type="text"/>	First Name 2 <input type="text"/>	First Name 3 <input type="text"/>
Second Name 1 <input type="text"/>	Second Name 2 <input type="text"/>	Second Name 3 <input type="text"/>
Address 1 <input type="text"/>	Address 2 <input type="text"/>	Address 3 <input type="text"/>
Town 1 <input type="text"/>	Town 2 <input type="text"/>	Town 3 <input type="text"/>
County 1 <input type="text"/>	County 2 <input type="text"/>	County 3 <input type="text"/>

I have registered on [tradesmen.ie](#) & I need your reference, please text me back on this number with a reference for work that I have done if you are happy with it, many thanks [Ilya Biryukov](#)

Figure 3. Reference gathering screen.

Job Name & Description	Trade	Budget in Excess of	Location	Date
Gas Boiler Service Gas service of Boiler Check Radiator	Heating Contractor	€0	navan Meath	16/11/2010
Plans for extension We were looking to get plans drawn up for an extension to the back of our house. We do not want to have to get planning permission so we will be keeping it below the max sq ft allowed	Architect	€20,000	Dun Laoghaire Dublin County South	16/11/2010
Xmas Market To fit a sink at the Fitzwilliam Square Xmas Market	Plumber	€100	Dublin Dublin 2	16/11/2010
Gas Fitter for Xmas Market To test and certify all Food Traders who use gas to cook with at the Fitzwilliam Square Christmas Market.	Gas Fitter	€400	Dublin Dublin 2	16/11/2010
tile wall and floor to fit floor tiles to a small kitchen floor and to fit wall tilesto a small bathroom.	Tiler	€30	kilmeague Kildare	16/11/2010
replace a radiator replace a radiator	Plumber	€30	dublin 15 Dublin 15	16/11/2010
external insulation external insulation required	Builder	€3,500	dublin Dublin 3	16/11/2010
sunroom sunroom at rear roughly 10x10	Builder	€5,000	dublin Dublin 13	16/11/2010
dryer belt dryer belt to be fitted hotpoint aquarius have the belt just needs to be fitted	Appliance Repairs	€30	co kildare Kildare	16/11/2010
Metal Gutter This job I want to preserve an old metal gutter which is flooding over. Several men have looked at it without solving the problem, there seems to be no leak, might need flashing at the back and repaint. more...	Gutters Fascia & Soffit	€200	Terenure, D6w Dublin 6w	16/11/2010
roof/ceiling repair roof/ceiling repair	Roofer	€300	Balbriggan Dublin County North	16/11/2010
cavity & attic ventalation cavity & attic ventalation also heating controls	BER Assessor	€0	galway Galway	16/11/2010
Alarm Engineer I have an Astec Alarm that is now showing Error message of "15 Call Engineer"	Alarms - Security & Fire	€30	Dublin Dublin 3	16/11/2010
Coming to windows				

Figure 4. Job listing

Process Bids

Before a tradesman can start bidding, he must have the registration fee of €165 paid which consists of €65 account opening fee and €100 worth of leads credit in advance.

Below are the rules by which the leads are currently sold through the bidding process:

Leads will be sold to the first 4 tradesmen to text back as normal but each time we run this new script it will check all messages that have the format Leadid:Bid and for each distinct Leadid if NumMins mins have passed it will run a function that will sell the lead to tradesmen who have bid less than the lead price subject to certain conditions.

It will take the lowest of the top 3 bids above a certain price (LeadPrice * MaxDiscount) received within NumMins mins and send it to these 3 tradesmen for this price. For example let's say there is a lead id of 15000 and the lead price for it was €20. Let's say there is Tradesmen 1 (T1) , Tradesmen 2(T2) and Tradesmen 3(T3) ... Tradesmen n (Tn). Let's say NumMins = 30 mins and MaxDiscount = 50%. Below we have Case 1 and Case 2 which shows the messages that the tradesmen T1 – T7 sent for leadid 15000 and the result we should get after ProcessBids(Leadid) has run.

Case 1

LeadID = 15000. LeadPrice = €20. tr_LeadsOffered.Timestamp = 31/12/2009 15:56:26

T1 – tr_ReceivedSMS.Message = 15000, tr_ReceivedSMS.Timestamp= 31/12/2009 15:58:10 (this lead will be sold immediately to T1 for €20) **NumSold = 1**

T2 – tr_ReceivedSMS.Message = 15000:18, tr_ReceivedSMS.Timestamp= 31/12/2009 15:58:12 (wait NumMins mins... this lead will be sold to T2 for €15 (LeastBid)) **NumSold = 2**

T3 – tr_ReceivedSMS.Message = 15000:5, tr_ReceivedSMS.Timestamp= 31/12/2009 15:59:24 (wait NumMins mins... not sold to T3, BidPrice is less than 50% of the leadprice)

T4 – tr_ReceivedSMS.Message = 15000:15, tr_ReceivedSMS.Timestamp= 31/12/2009 15:59:30 (wait NumMins mins... this lead will be sold to T4 for €15 (LeastBid)) **NumSold = 3**

T5 – tr_ReceivedSMS.Message = 15000:15, tr_ReceivedSMS.Timestamp= 31/12/2009 15:59:32 (wait NumMins mins... not sold to T5, NumSold = 3)

T6 – tr_ReceivedSMS.Message = 15000:18, tr_ReceivedSMS.Timestamp= 31/12/2009 16:48:42 (not sold to T6, tr_ReceivedSMS.Timestamp - LeadsOffered.Timestamp > NumMins and NumSold = 3)

T7 – tr_ReceivedSMS.Message = 15000, tr_ReceivedSMS.Timestamp= 31/12/2009 16:58:06 (this lead will be sold immediately to T7 for €20 because NumSold < 4) **NumSold = 4**

Software Platform

The current version of this application is written in classical ASP as the server-side language. It uses standard HTML4 and CSS2 to render the pages. The database used is SQL Server 2005 Express Edition.

The web site is hosted on a Windows Server operating system under IIS (Internet Information Services) web server.

The web site uses third party APIs that enable it to carry out communication through mobile phone text messages – both sending and receiving. I am not aware of the API being used. However, most likely it is a REST (Representational State Transfer) API that enables communication with any programming language or platform that can send and receive HTTP data.

Existing Ranking Algorithms

Importance of Ranking

The World Wide Web, as we know it today, is a highly anonymous place where people enjoy almost complete privacy. It enables unlimited possibilities for communication between strangers as well as other activities such as selling and buying, exchange of information, etc.

Such communication happens between individuals uninformed of their opponents past history of activities and the quality of their character. However, these circumstances do not pose a problem when only simple communication is carried out between several individuals. For example, a chat room, or e-mail exchange does not pose a great danger to one's safety. However, internet grew into something more than just a big chat room with the help of different technologies. It now allows carrying out online auctions, selling goods online and similar activities. It is clear that the virtual space has gradually moved in to the realm of the real word and blurred the distinction between two. What happens online can easily affect you in real life and very often it does.

Therefore, in order to promote safety and good behaviour online while preserving and respecting individuals' right to privacy we need to employ effective and fair reputation and ranking systems. Such systems would need to analyse past behaviour of users and present them in an easy and understandable way. They should not reveal any private information about a person, but should provide a rank for that person that is quantifiable on a certain scale – that is comparable to ranks of other participants of the system.

If we examine how real-world relationships evolve, we would see that it is much harder to build trust between strangers as they are not aware of the opponents past history and activities. While online, strangers are not subject to a group of informed individuals who would punish bad and reward good behaviour. These factors increase the temptation of "hit and run" and general abuse of the system because any bad behaviour would not damage one's good name, reputation or cast a shadow over one's future (2).

Reputation systems help to set an expectation about a certain individual. Individuals, in turn, that are genuinely interested in participating in a certain system that is beneficial to them in some way would strive to increase their reputation (rank) to show their trustworthiness to others and to gain full benefit that the system offers.

We take EBay as an example - the biggest online auction on the web. It allows its users to rate transactions that they have with other members of the system either positively (+1) or negatively (-1). Thus, both buyers and sellers have a rank (a sum of all given ratings and their average) and a collection of short feedback messages: "Fast sale, good person to deal with" or "Great buyer. Highly recommended."

The high success of EBay is attributed to its ranking system (2). It creates safe environment for its users and provides the tool (rank & feedback) that allows users to judge the degree of safety of a possible transaction they are considering to carry out. While it doesn't affect ones privacy, it provides a person's history of activities in a way that is easy to read and interpret. It encourages individuals to act fairly and gives them something to lose which their reputation. Bad reputation in

EBay would decrease the chance for a sale while good reputation will most certainly have a positive effect on this chance.

In general, such ranking systems that create reputation among users have a very positive effect on the eco system of the platform that employs it. They are effectively self-policing systems that will filter out the users who are trying to abuse it by reducing their rating and will promote trustworthy users by increasing their rating.

On the other hand, the ranking system itself should have a mechanism of self-protection against misuse. As with any algorithm, ranking algorithms are prone to manipulation and false increase. If one knows the algorithm well enough by either studying its behaviour closely or from a successful reverse engineering attempt, one should have no difficulties in manipulating the algorithm in their own favour, thus, completely avoiding algorithm's regulatory functions inside the system. Therefore, such algorithms should never be released with their full details.

Google Page Rank



Google's search technology is called PageRank™ **(PR)**. It assigns an "importance" value to each page on the web and gives it a rank to determine how useful it is (3). The word "Page" in PageRank, in fact, refers to the co-founder of Google – Larry Page, but

not the actual internet pages (4).

PageRank reflects the importance of web pages by considering more than 500 million variables and 2 billion terms (5). Pages with higher PageRank are more likely to appear at the top of the search results list (3).

The PageRank is determined by Google Search bots that traverse the web continuously saving copies of web pages, extracting the links from the pages and following them. This process never stops and is constantly running ensuring that changes made to pages in websites are reflected in Google's database (5).

Next Google processes these pages and creates an index, like an index in a book. When a search is query is typed in by a user, Google analyses the index of web pages it has stored and returns the most relevant results (5).

PageRank is a very important algorithm. If we consider the characteristics of the World Wide Web we would see that the number of pages it contains increases exponentially over time and goes to infinity. In order to provide meaningful results to search queries, the search algorithm would need to take in to account not only the relevance of the page to the search query but also be able to sort the obtained results in such a manner that the most relevant ones would appear at the top of the list since users only look at the first ten results and rarely go beyond that (6). PageRank ensures that the most relevant results which are the most popular pages appear in the list at the very top.

Definitions of Page Rank

The PageRank algorithm creates a mathematical graph where the web pages are the nodes and the hyperlinks are the edges. A hyperlink to a page from an external source acts as a vote of support for that page. PageRank counts the number of links leading to a page and the PR of the pages that contain those links. It combines these values to produce a PR for the page which is in essence a citation metric (6).

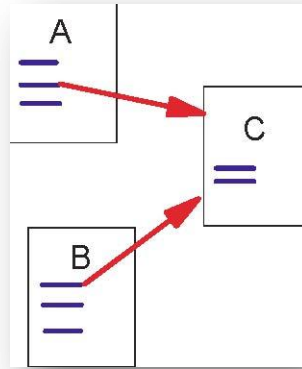


Figure 5. A and B are backlinks of C (7)

Web pages vary in terms of how many backlinks they have. Generally highly linked pages are more important than pages with a few backlinks (7). Simple citation counting has been used to speculate on the future winners of the Nobel Prize (8).

However, simple citation count is not an ideal measure for the importance of a web page because not all of the backlinks are of the same importance value. For example, if we have a page that has a backlink from a simple home page that itself has a small PR value and then we have a page with a backlink from a very popular web site like yahoo. Those backlinks cannot be assumed to have identical value (7).

PageRank takes this factor into account and the original PageRank was defined as follows:

“We assume page A has pages $T_1 \dots T_n$ which point to it (i.e., are citations). The parameter d is a damping factor which can be set between 0 and 1. We usually set d to 0.85. Also $C(A)$ is defined as the number of links going out of page A. The PageRank of a page A is given as follows:

$$PR(A) = (1-d) + d (PR(T_1)/C(T_1) + \dots + PR(T_n)/C(T_n))$$

Note that the PageRanks form a probability distribution over web pages, so the sum of all web pages' PageRanks will be one.” (6)

A more detailed description and algorithm of PageRank is provided in (7):

Definition 1.

If we have a random internet surfer that surfs the web, the PageRank of page A is the probability of that the surfer will arrive at that page.

Definition 2.

Let μ be a web page. Then let F_μ be the set of pages μ points to and B_μ be the set of pages that points to μ . Let $N_\mu = |F_\mu|$ be the number of links from μ and let c be a factor used for normalization (so that the total rank of all web pages is constant).

We begin by defining a simple ranking, R which is a slightly simplified version of PageRank:

$$R(\mu) = c \sum_{v \in B_\mu} \frac{R(v)}{N_v}$$

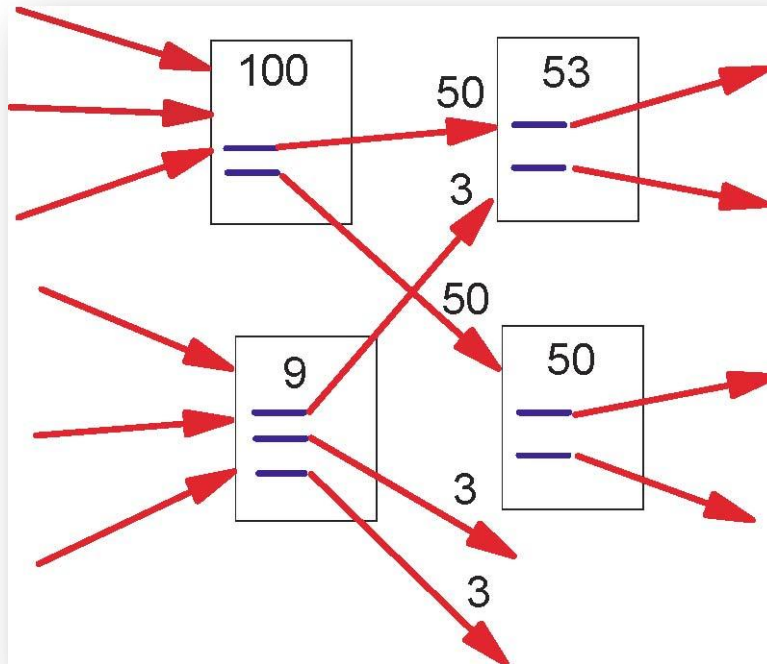


Figure 6. Simplified PageRank Calculation

In figure 6 we see a set of rectangles that represent pages and arrows leading to and away from pages represent hyperlinks between those pages. At the tail of an arrow is the source page, and the head of an arrow is the page the link leads to. Also, as it can be seen from the diagram and formula above, the rank of the page is split evenly among the outgoing links.

There is a small problem with this simplified ranking function. Consider two web pages that point to each other but to no other page. And suppose there is some web page which points to one of them. Then, during iteration, this loop will accumulate rank but never distribute any rank, since there are no outedges. The loop forms a sort of trap which we call a rank sink.

To overcome this problem a rank sink is introduced:

Definition

Let $E(\mu)$ be some vector over the Web pages that corresponds to a source of rank.

Then, the PageRank of a set of Web pages is an assignment, R' , to the Web pages which satisfies

$$R'(\mu) = c \sum_{v \in B_\mu} \frac{R'(v)}{N_v} + cE(\mu)$$

such that c is maximized and $\|R'\|_1=1$ ($\|R\|_1$ denotes the L_1 norm of R')

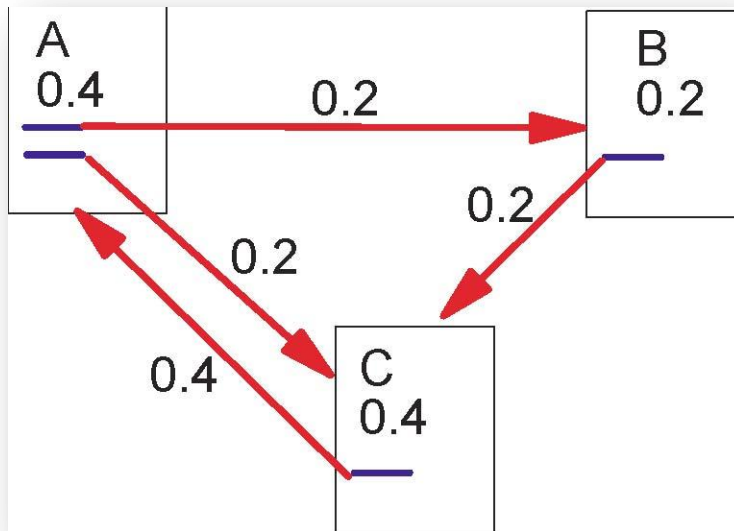


Figure 7. Simplified PageRank Calculation

This updated model above can be compared to a random surfer who would not be caught in a loop if the pages are inclosed in one, but rather would get bored of surfing the same pages repeatedly and eventually pick another random page to start with from a set of pages that are outside the given loop.

Criticism

Google page rank is one of the most successful rating systems in the world. Google is the global leader in the web search field. Over the years the algorithm was refined and improved yielding very accurate results to most the of the search queries in many languages.

Page rank is also implements security measures that help prevent the algorithm abuse and false increase. The details of these measures are not revealed by Google for obvious reasons. However, from conducted tests, it can be seen that PageRank will detect pages with pages with exhaustive amount of links and classify those pages as spam. Furthermore, PageRank is HTML aware. It will not read links which are hidden or positioned to be outside the browsers view area.

EBay Reputation System



EBay is an American online auction and a shopping web site in which individuals and businesses buy and sell a broad variety of goods and services world-wide. EBay was founded in 1995 and grew into one of the leading online auctions with net income of over \$2 billion in 2009 (9).

EBay itself as a company is only a platform provider and doesn't sell goods. Instead it allows businesses and individuals to list their products and services and lets other users of the system bid on those items, usually in a given timeframe before the auction expires. The top monetary bid wins the item and the bid owner, by the rules of the auction, is required to buy that item, as an act of placing a bid is a binding contract between the buyer and the seller according to EBay's terms and conditions.

Taking into account the nature of business EBay is involved in – buying and selling between strangers online, it is of paramount importance for EBay to adopt a good reputation system that will protect each user and ensure that the majority of deals are done safely. The reputation system would need to provide incentive for all members to act fairly within the system and to obey its rules.

EBay is one of the earliest and best known Internet reputation systems which gradually evolved over time and underwent several amendments in its history. It gathers feedback from buyers and sellers about each other after each transaction (10).

Before participating in any auctions, as either buyer or seller, people (henceforth called users, as in users of the auction service) register, providing their personal information to eBay, including name and contact information. The only information that eBay verifies, at least for buyers, is that the email address is valid by sending out a confirmation e-mail (10).

Then, users are allowed to enlist items in EBay's catalogue and create an auction for each of items specifying the starting bidding price and the deadline for the auction. Buyers, on the other hand, place bids for the given item and the top bid wins it.

Once the transaction is complete, the seller and the buyer leave feedback about each other. Feedback represents the reputation of an EBay member. It is made up of comments and ratings left by other members that an EBay member have bought from and sold to. This indicates that an EBay member can use their account for both selling and buying activities. The feedback from those activities is well distinguished and can be viewed separately (11) (see figure 8).

The process of leaving feedback consists of choosing the type of feedback you are willing to leave: Positive, Neutral or Negative, and the transaction to associate the feedback with. It is not allowed to leave general feedback about users, it must be left for a specific transaction that you, as a user, were involved in. Then you are required to type a short message describing your experience. The above is true for both buyers and sellers. However, there is one addition in case when a buyer leaves feedback about a seller. The buyer is requested (but not required) to rate four additional items on a scale from 0 to 5 stars. This rating is called detailed seller rating (DSR):

1. Items as described.
Are the received items exactly as the seller described them? The Title and description, appearance, age, functionality, etc.
2. Communication
If communication with the seller occurred, it should be rated. Consider how many days it took for the seller to respond and deal with your question or issue.
3. Dispatch time
How long did it take from the moment the buyer paid for the item to the moment it was dispatched
4. Postage and packaging charges
Affordability of P&P Charges. Sellers employ overpriced P&P charges to make up for the cost of the item. This rating item is an attempt to reduce the frequency of such occurrences

(12).

What distinguishes DSR from general feedback, that is the type of experience (Positive, Negative or Neutral) and the general feedback message, is that DSR is anonymous. The sellers cannot see what DSR feedback was left by what user. This feedback is displayed as an average total. For better understanding of DSR please refer to **C** in the table below.

Feedback for each user is freely available for other members of the EBay to see. Any user can view it and decide if any given user is worth dealing with.

Figure 8 shows the feedback profile currently employed by EBay that is derived purely from users' feedback. The table below provides a detailed explanation of what each section means.

What is it	What it means
A: Positive Feedback rating	<i>The percentage of positive ratings left by members in the last 12 months. This is calculated by dividing the number of positive ratings by the total number of ratings (positive + negative).</i>
B: Recent Feedback ratings	<i>The total number of positive, neutral and negative Feedback ratings the member has received in the last 1, 6, and 12 months.</i>
C: Detailed Seller Ratings	<i>Detailed seller ratings provide more details about this member's performance as a seller. Five stars is the highest rating, and one star is the lowest. These ratings do not count toward the overall Feedback score and they are anonymous. That means that sellers can't trace detailed seller ratings back to the buyer who left them. Detailed seller ratings from the same buyer are counted in the same way as Feedback. Only one every week is included in the seller's score.</i>
D: Bid retractions	<i>The number of times the member has retracted a bid in the last 12 months. To see the number of bid retractions, click the "Feedback as a buyer" tab.</i>

(13)

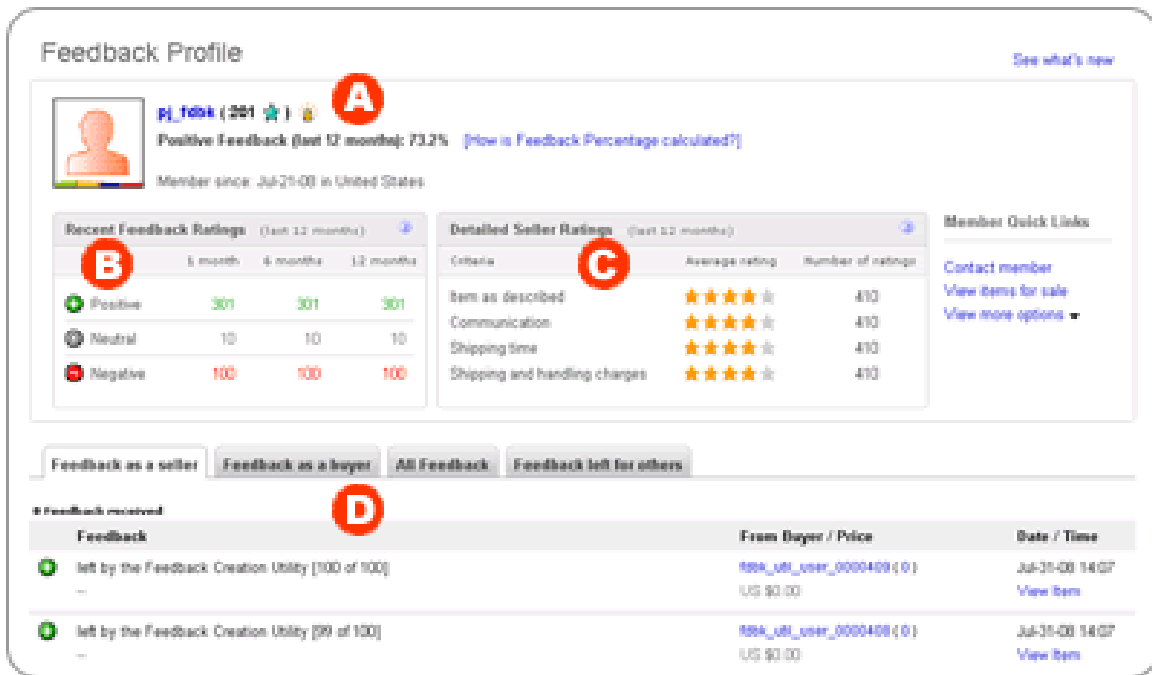



Figure 8. Feedback profile example (13)


Feedback is very important part of one's profile in EBay. It allows users to evaluate other member's feedback easily and it creates a self-policing environment where users are encouraged to thrive for the best possible feedback profile.

Furthermore, EBay employs a "star" feedback meter which is an easy way to see good sellers. If you look at the nickname of the user in figure 8 above, you will see that there is a star beside it. This star is colour coded and based on the level of the score the star changes its colour and above certain score it changes into a "shooting star". This is an easy way for users to see the rating of other members without going into their feedback profile and examining the specifics of the feedback.

EBay employs the following mapping between the positive rating score and the star appearance:

- Yellow star (★) = 10 to 49 ratings
- Blue star (★) = 50 to 99 ratings
- Turquoise star (★) = 100 to 499 ratings
- Purple star (★) = 500 to 999 ratings
- Red star (★) = 1,000 to 4,999 ratings
- Green star (★) = 5,000 to 9,999 ratings
- Yellow shooting star (★) = 10,000 to 24,999 ratings
- Turquoise shooting star (★) = 25,000 to 49,999 ratings
- Purple shooting star (★) = 50,000 to 99,999 ratings
- Red shooting star (★) = 100,000 to 499,999 ratings

Green shooting star () = 500,000 to 999,999 ratings

Silver shooting star () = 1,000,000 ratings or more
(13)

Powerseller Accounts

EBay makes a clear distinction between ordinary sellers and sellers with exceptional history of sales. These sellers are called “Powersellers”. They are especially highlighted in the system to make them more visible to other users and their items appear higher in the search list which promotes the items they have on sale.

However, there are tough requirements imposed by EBay for becoming a PowerSeller. In order to achieve and maintain this status you will need to have a proven track record of both quality and quantity of your sales.

Feedback and detail seller ratings (DSRs) requirements:

- *100 minimum feedback*
- *98% positive feedback over the past twelve months*
- *Minimum average detailed seller ratings (DSRs) of 4.60 or higher for all four DSRs - item as described, communication, shipping time, and shipping and handling charges.*
 - *For sellers that sell exclusively in Motors Vehicles categories, DSR requirement applies to item description and communication DSRs only*
 - *For sellers that sell exclusively in Half.com the shipping and handling charge DSRs does not apply*
- *Rates of 1s and 2s* on DSR with US buyers not to exceed the following rates and counts:*
 - *Items as described: 1% and a count of 3*
 - *Communication: 2% and a count of 3*
 - *Ship time: 2% and a count of 3*
 - *Shipping & handling charges: 2% and a count of 3*

** The time period for evaluation for the average DSR and rates of 1s and 2s on DSRs is the most recent three calendar months for sellers with 400 or more transactions during those months. For all other sellers, the time period for evaluation is the most recent twelve calendar months.*

(14)

Also, there is a minimum sales volume requirement

- *Minimum sales volume with US buyers over past 12 months: \$3,000 in sales and 100 transactions*

(14)

There are five tiers of PowerSellers based on sales volume. Although all PowerSellers are eligible for PowerSeller benefits and Top-rated seller status, sellers that reach higher PowerSeller tiers will be provided greater customer support. Sellers who meet the minimum sales volume requirement qualify as a Bronze PowerSeller. Additional PowerSeller tiers are as follows:

PowerSeller Tier	Silver	Gold	Platinum	Titanium
<i>Average monthly volume:</i>				
<i>Sales</i>	<i>\$3,000</i>	<i>\$10,000</i>	<i>\$25,000</i>	<i>\$150,000</i>
OR				
<i>Items Sold</i>	<i>300</i>	<i>1,000</i>	<i>2,500</i>	<i>15,000</i>
<i>Customer Support</i>				
<i>Email & chat</i>	<i>24 hours</i>	<i>24 hours</i>	<i>24 hours</i>	<i>24 hours</i>
<i>Phone</i>	<i>6am-10pm</i>	<i>24 hours</i>	<i>24 hours</i>	<i>24 hours</i>
<i>Specialised Account Services</i>	<i>No</i>	<i>Some</i>	<i>Yes</i>	<i>Yes</i>

(14)

As we can see, PowerSellers not only enjoy a more attractive spot in the search result but also receive special support from EBay who should be and is genuinely interested in profitable participants.

EBay Reputation Criticism

EBay allows buyers to write short feedback messages about the transaction they had with a seller. And the seller is allowed to respond to that feedback message if they think it is necessary to do so. These are great features of the reputation system. However, the messages are only allowed to be 80 characters long (15). In some cases this prevents users from fully describing the issues they encountered with the seller. And the seller has extremely limited message to respond to given complaint. Links are not allowed to be included in feedback messages.

Furthermore, EBay does not distinguish between transactions. Each transaction made on EBay carries the same weight. Some believe it is unfair to treat large transactions (car sale, etc) and small transaction (audio book, digital goods) as of the same importance. This creates a situation where a seller can build up a good rating profile with small and easy sales before switching to fraud.

Proposed Ranking Algorithm

Below is the algorithm I propose for Tradesmen.ie.

Each contractor will have two ranks (personalised index):

1. Overall rank
2. Adjusted in-time rank

Overall Rank

The overall rank is a rank accumulated by the completeness of the tradesmen profile, the tradesman activity on the system and reviews given by his customers.

The full and initial profile rank value of 1 is awarded to tradesmen if they have completed their profile in full. Otherwise, for incomplete or empty profiles tradesmen receive a reduced rank value of 0.9. This promotes openness among tradesmen and potentially reduces the chance of dishonest tradesmen winning a lead.

The activity on the system consists of 3 parts. Each activity should be recorded by the system and alter the rating of the tradesmen. Rating alteration can alter the rating in both ways – positively and negatively.

1. Placing bids.

Each lost bid should be awarded from 0.0001 to 0.0009 which is added to the overall rating. The top monetary lost bid will get 0.0009 and other 8 bids (if they exist) will get the corresponding value from the above range. This feature is aimed at promoting active users who place high bid values but don't get the lead because somebody else has better rating (probably due to longer participation in the system) which increases their bid equivalent.

2. Winning bids.

The top 4 winners will be awarded 0.001 to their rating.

3. Getting the job (chosen from the competition of 4)

The tradesman who got the job will be awarded 0.01 to his rating and this figure will be adjusted by the review that will be provided by the client.

The review will be given out of 10 stars. 6 stars will not modify the above figure. However, below 6 stars will decrease it, and above 6 stars will increase the figure.

Stars	1	2	3	4	5	6	7	8	9	10
Factor	0	0.1	0.3	0.6	0.9	1	1.2	1.4	1.6	2

getFactor(Stars) function

Adjusted In-Time Rank

The adjusted in-time rank is an adjustment system that will only adjust tradesmen rating temporarily for a single bid only. It will take into account the personal history of the tradesman and the customer and based on the successfulness or lack of it, it will modify the rating to either promote the bid or decrease its value. This algorithm executes only if a tradesman bids on a customer's job and they dealt with each other previously.

Adjusted in-time rank will be calculated by getting an average of all ratings (stars) given to the tradesman by the customer, executing the getAdjustedFactor function and adding the result to the current rank of the tradesman.

Stars	1	2	3	4	5	6	7	8	9	10
Factor	-1.8	-1.6	-1.4	-1.2	-1.1	1	1.2	1.4	1.6	2

getAdjustedFactor(Stars) * 0.1

Sample Execution

	Bob	Mark	John	Paul	Kevin	Big ears	Cool Joe
Initial Rank	1	0.9	1	1	0.9	0.9	1
Bids Made	50	45	70	10	2	3	150
Bids Won	10	11	9	1	0	0	25
Jobs Got	1	2	4	0	0	0	11
Combined Rank	1.04	0.949	1.077	1.005	0.9008	0.9012	1.195
Jobs							
Job A Bids	€ 20.00	€ 30.00	€ 25.00	€ 22.00	€ 35.00	€ 31.00	€ 20.00
Job A Indexed Bid	€ 20.80	€ 28.47	€ 26.93	€ 22.11	€ 31.53	€ 27.94	€ 23.90
		2	4		1	3	

The combined rank is updated for each tradesman with the progress of activity. The combined rank is used to produce the indexed bid which equals to the bid value multiplied by the combined rank. And finally, the indexed bid is used to pick out the top four tradesmen who the lead will be sold to.

Remarks

The variables proposed above are floating point numbers. It might be worth considering operating with whole number integers while running the algorithm on a computer and then dividing the result by an appropriate multiple of ten (10) to obtain the required number. On the software level, this approach can help to avoid the famous floating point error¹ and on the database level, we can speed up fetching and saving of data as databases operate faster with integers rather than floats. Also integers require less hard disk space compared to doubles.

Algorithm Test

For the purpose of testing the proposed algorithm and visualising the output data I wrote a special tool that executes the algorithm against user generated data. A screenshot of the tool can be seen below.

¹What Every Computer Scientist Should Know About Floating-Point Arithmetic
http://docs.sun.com/source/806-3568/ncg_goldberg.html

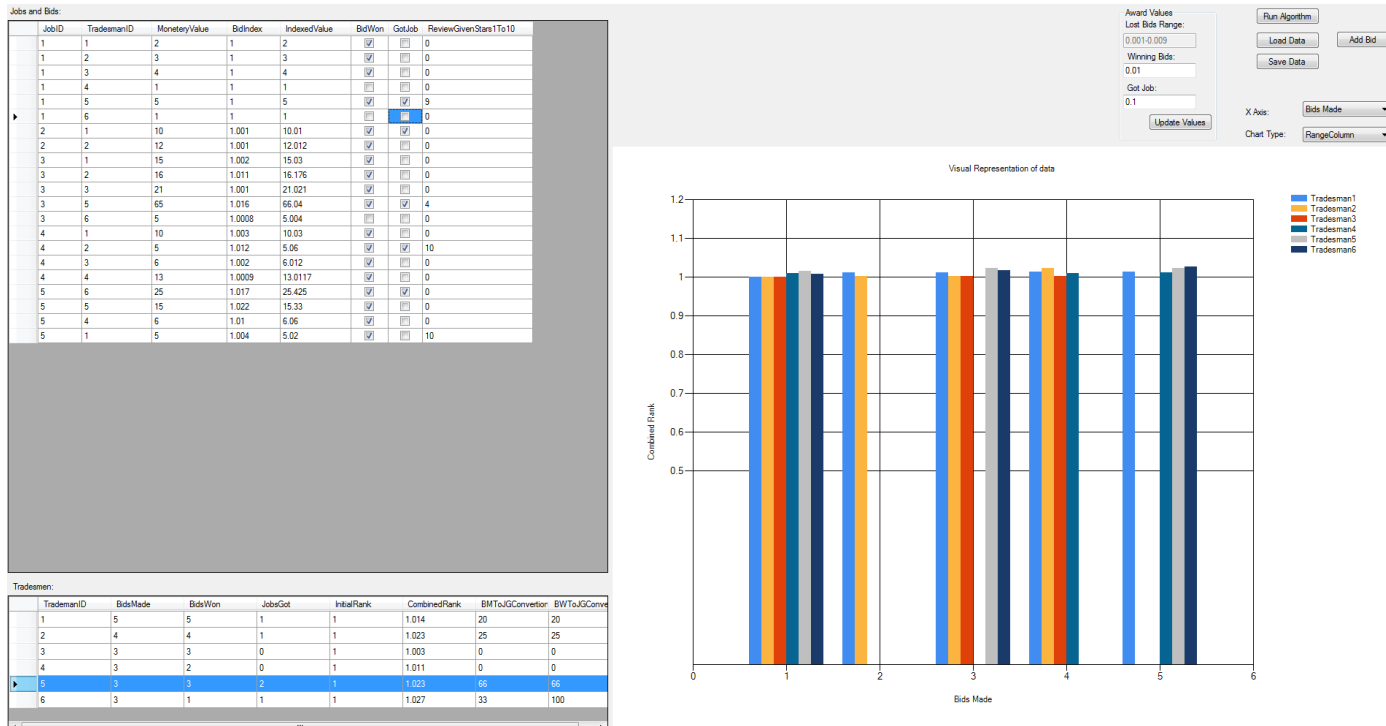


Figure9. Algorithm Test Tool

To work with the tool, you must follow these steps:

Press “Load Data” button and in the new window that appears select the data file that I provide with the tool.

The file contains three serialised objects that hold data regarding Jobs, Bids and Tradesmen. Once the data is loaded you will see the screen above.

The first grid view “Jobs and Bids” shows the bids made for jobs by tradesmen. You can edit the monetary value of the bid, make a bid “get the job” and give that bid a review on the scale of 1 to 10.

The rest of the fields serve the following purpose:

- The monetary value is the actual bid the tradesman placed.
- The bid index is the rank of the tradesman at the time of placing the bid
- Indexed value is the monetary value multiplied by the bid index
- Bid won is a flag that indicates the winning bids for the job. This flag is assigned automatically by the algorithm and is given to the top 4 bidders with the top indexed value bid
- Job got is a flag which indicated a bid that got the job. It can be assigned to only one bid the job. Several people cannot be given the right to carry out a job
- Review Given Stars is an emulation of a review given by the customer to the tradesman that got the job.

The second grid view “Tradesmen” is the list of all tradesmen known to the system and their profile information:

- BidsMade – how many bids the tradesman placed
- BidsWon – how many of the bids are winning bids
- Jobs Got – how many jobs did the tradesman get
- Initial Rank – tradesman rank at the time of registration of the web site
- Combined Rank – Current up-to-date rank which is used as BidIndex
- BMTToJGConversion – Bids made to Jobs Got Conversion in per cents
- BWTToJGConversion – Bids Won to Jobs Got Conversion in per cents

The looking at the top right corner, there are a number of inputs available to adjust the variable values used in the algorithm. These values are documented in the list above. Please not, that they were intentionally increased by the factor of 10 to provide a better differential for the graph.

“Run algorithm” button executes the ranking algorithm. However, most of the input events to the interface trigger that algorithm automatically. I left the button in case I missed some events.

“Load data” button allows the data to be loaded from file and the “Save data” button does exactly the opposite – save current data to a file.

Add bid button brings up a new screen that allows a new bid to be added and a new job to be created. With the current data file that I provide, there are 5 jobs included. The user may want to create more jobs and assign bids to them to test the algorithm further.

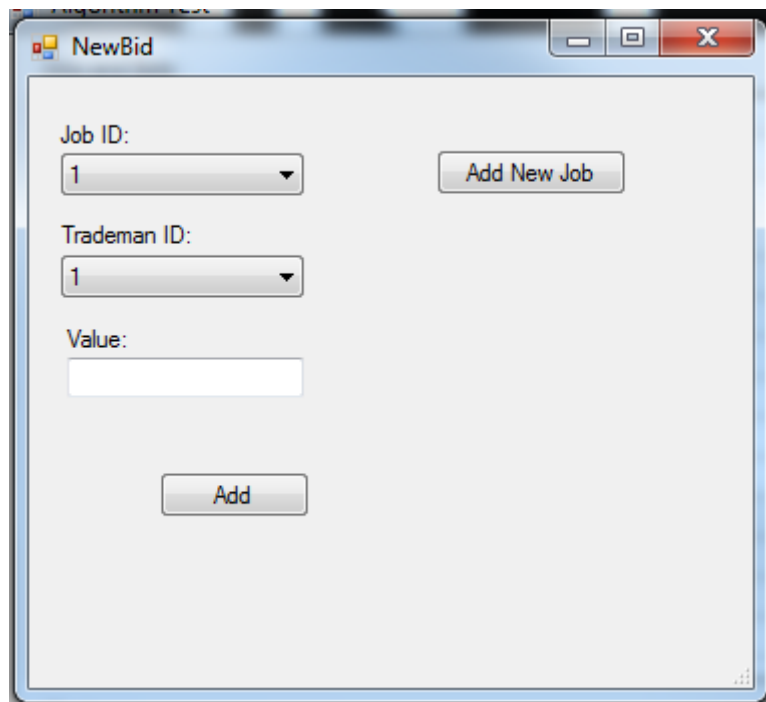


Figure 10. New Bid Screen

X-Axis combo box allows the data to be configured that the X-Axis of the graph will contain – Bids made or Job ID.

The chart type is simply the type of the chart to use on the graph. By Default I chose the Range Column, which I believe is the most self-explanatory chart and the easiest to read. However, line

chart can be also used. I provide all the chart types shipped by Microsoft Charting Controls to choose form.

And finally, the graph area itself displays the visual representation of the data above.

Available Software Platforms Overview

In order to create this web based project I will need to choose a suitable server-side programming language possibly along with a framework, a database, front end language such as html and JavaScript. Below I will document the languages and tools I have researched.

Programming Languages

Web development has moved a long way since the early days. The web evolved from a static paradigm where all pages were hardcoded with data in HTML to a fully dynamic paradigm where at the time of the page request, HTML is generated on the fly based on tens or even hundreds of variables and conditions. Such a language is referred to as a server-side language because it executes on the server and not on the client (i.e. web browser). It executes its program, a series of statements, talks to various data sources such as files, databases and other servers, and then generates a unique HTML code especially for the client and sends it back to the client's machine. To be more precise, the data returned from the execution of a server-side script is picked up by special web server software that is responsible for communication between the server and the client. This communication architecture is called Client-Server architecture.

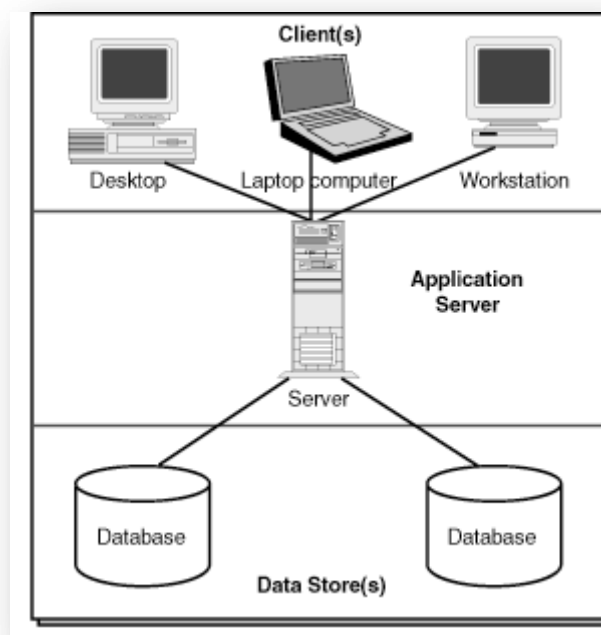


Figure 11. Client-Server architecture

With the rapid development and growth of World Wide Web, the languages evolved to suit the purpose. In fact, there are a great number of languages available for the job to suit any taste and flavour. There are both proprietary and open source languages available for web development.

PHP

Overview



- *“PHP is a widely-used general-purpose scripting language that is especially suited for Web development and can be embedded into HTML.” (16)*
- *“PHP is an HTML-embedded scripting language. Much of its syntax is borrowed from C, Java and Perl with a couple of unique PHP-specific features thrown in. The goal of the language is to allow web developers to write dynamically generated pages quickly.” (17)*

PHP: Hypertext Preprocessor was originally developed in 1995 by Rasmus Lerdorf. The language is free and open source and is released under a special PHP licence. (18) There are currently two stable branches in production PHP 5.2.x and PHP 5.3.x.

PHP is a general-purpose scripting language. It is especially suited for server-side web development and generally runs on a web server such as Apache. The language is developed by the open source community. However, Zend Technologies (the PHP Company) is the biggest contributor to the language source code. (19)

PHP programs are executed by the interpreter at run time. PHP is not shipped with a compiler which makes it impossible to compile a program into binary code. Instead, at the time of execution the interpreter reads the source code, compiles it into bytecode and then the Zend Engine executes it. However, there are a number of third party tools and language extensions available that can cache the bytecode and prevent the interpreter from running every time the request for a script execution comes in. Such tools greatly improve the execution and response time.

The absence of compiler makes digital delivery to a customer of software written in PHP a highly risky activity because the entire source code needs to be provided. It makes software written in PHP vulnerable to piracy, illegal use and redistribution. However, in order to protect the intellectual property, there are a number of source code obfuscators available that will obfuscate and encrypt the source code. It is necessary to install a PHP plug-in that will decrypt the source code at run time.

One very strong point about PHP language is the quality of its documentation. It is always up to date, well written and accompanied by filtered and carefully selected user comments that enhance it greatly. The documentation is highly searchable. Anything that is typed in to Google search engine that is even remotely PHP related will most certainly return a result from the official manual that will provide you with a straight answer to your question. This is a very important aspect of the language as any arisen difficulty related to the language is searchable.

Features

PHP interpreter is cross-platform. It is available for Windows, Linux and Mac OS. It generally runs under a web server especially in Web environment. On Windows, Mac and Linux it can run under Apache web server either in Fast CGI mode or as an Apache module. If PHP is installed in CGI mode, every time a request for a page comes in, Apache spawns a new PHP process, it gets initialised (reads configuration files), executes the script, terminates and then destroyed by Apache. On the other hand, if PHP is installed as a module of Apache, PHP interpreter get initialised only once when Apache server starts up. This makes PHP a bit faster because it doesn't need to reinitialise itself every time it runs. However, this performance boost, as usually the case, comes with flexibility penalty. If the web server administrator needs to change the configuration of PHP the whole apache server environment would need to be restarted making the web server unavailable temporarily. However, if PHP is installed in CGI mode, the next time it is initialised to serve a page request it reads an updated configuration file, therefore, making it unnecessary to restart Apache server.

On Windows platform PHP can also run under Microsoft IIS (Internet Information Services) server version 6 and 7. PHP can only be installed in Fast CGI mode on IIS. (20)

PHP is a language with weak typing, dynamic type checking and weak type safety. PHP supports Object Oriented Programming (OOP) since PHP 4 (to a limited extent) and fully since PHP 5. In PHP 5.3 namespaces were introduced.

While developing in PHP, one is not required to use OOP. PHP code can be integrated directly into HTML files and inline with HTML code. PHP interpreter will only execute the code that is enclosed within PHP opening and closing delimiters (<?php code_here ?>) and the remaining information will be sent directly to output. Even though it is not a very good idea to embed code into HTML files from architectural, reusability and maintainability point of view, there is definitely a good use to this feature. The language itself can act as a template engine. If we were just to put variables inside HTML files and then inside our logic code assign values to them, we can implement a very small, fast and easy template engine.

PHP has a clear and easy to read syntax. The library of function in PHP come in flavour of actual function and not objects, that is if one wishes to perform an operation on a string such as bringing it to lowercase, one would need to call a built in function for this purpose (strtolower). This means that basic data types in PHP are not objects and do not contain functionality inside them. There is some criticism about the naming of built in function and a valid complaint that their names do not follow one universal naming convention. For example some built in functions that are made of several words are separated by an underscore and others are delivered as one continuous string. While this inconsistency certainly does not add any points to the elegance of the language, it would never pose a problem to a skilled software developer, as it is only the matter of time before these discrepancies are learned off by heart and the mind stops noticing them.

Sample PHP Script (21)

```
<?php
class Person {
    public $first;
    public $last;

    public function __construct($f, $l) {
```

```
        $this->first = $f;
        $this->last = $l;
    }

    public function greeting() {
        return "Hello, my name is {$this->first} {$this->last}.";
    }

    static public function staticGreeting($first, $last) {
        return "Hello, my name is {$first} {$last}.";
    }
}

$him = new Person('John', 'Smith');
$her = new Person('Sally', 'Davis');

echo $him->greeting(); // prints "Hello, my name is John Smith."
echo '<br />';
echo $her->greeting(); // prints "Hello, my name is Sally Davis."
echo '<br />';
echo Person::staticGreeting('Jane', 'Doe'); // prints "Hello, my name is
Jane Doe."

?>
```

Environments and Tools

Zend Environment

Zend Company offers a whole range of development tools along with a server, source encryption and cloud service.

Zend Studio

Zend Studio is an integrated development environment build on top of popular Eclipse IDE (www.eclipse.org). It ships in two versions:

1. PDT – PHP Development Tools. A free IDE based on eclipse with tools for PHP development
2. Zend Studio itself. A fully featured IDE with the most complete set of tools for PHP Development. It comes at very good price of \$300 per licence.

Zend Studio provides such powerful tools as:

- Code Refactoring
- Zend Framework Integration with complete MVC (Model View Controller) integration
- Zend Server Integration
- PHP Code generation – mutator functions (getters and setters), templates
- Code Completion & intellisense for php, JavaScript, HTML and CSS.
- Debugging. Including remote debugging and debugging in a virtual machine inside VMWare
- Unit testing framework
- Remote systems such as FTP & SSH
- Database management and development tools

(22)

Since Zend Studio is built on top of Eclipse IDE, it automatically gains the advantages of the whole repository of eclipse plug-ins that can be installed on any eclipse derived software. Currently there are over a thousand tools available in eclipse market place (23) that will satisfy virtually any need and requirement.

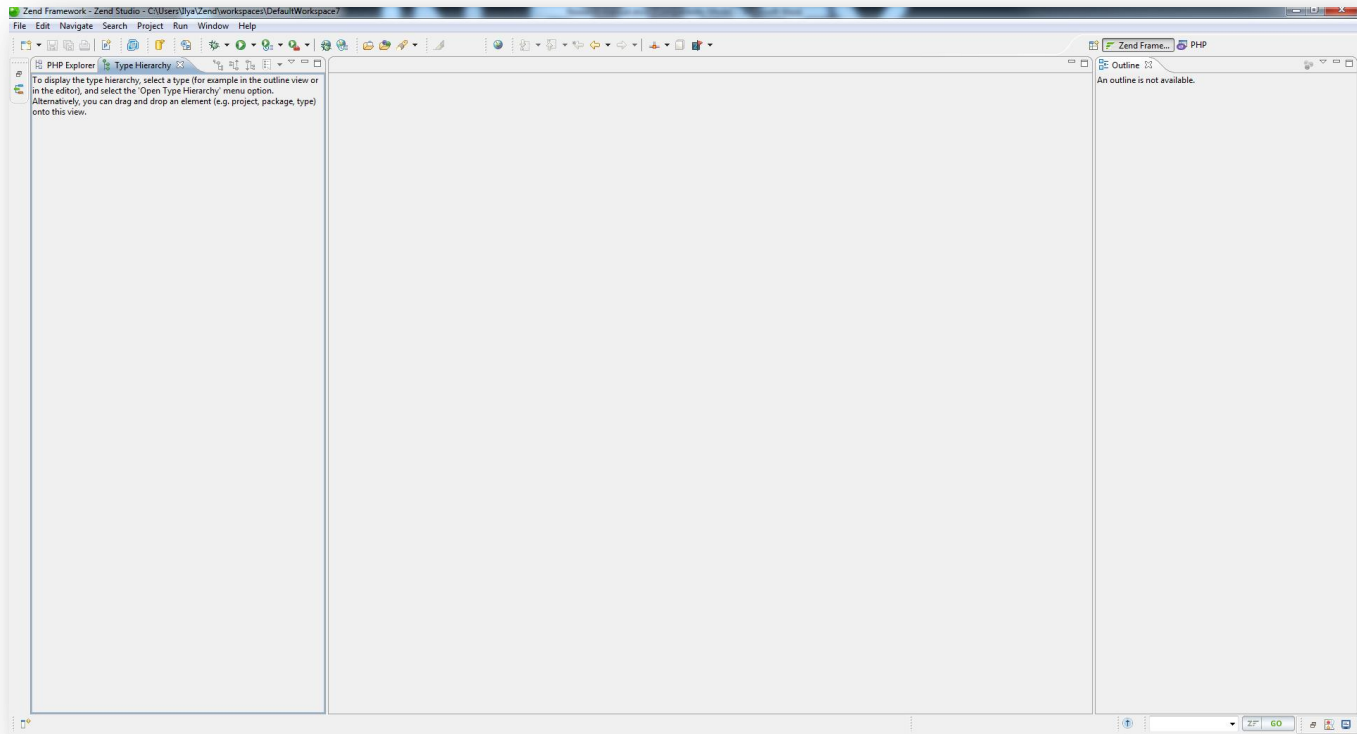


Figure 12. Default view of Zend Studio

Zend studio is a great development environment. It enables the programmer to focus on the solution and deliver it in the shortest possible timeframe. It is suitable for both sole developers and teams. It comes with collaboration tools build in and plug-ins that can connect to bug tracking systems, source versioning servers and deployment tools.

Zend Server

- *“Zend Server is a complete, enterprise-ready Web Application Server for running and managing PHP applications that require a high level of reliability, performance and security on Linux, Windows or IBM i.” (24)*

Zend server is a package shipped by Zend. It contains a full PHP stack that is easily installed in minutes. It will configure your server with all necessary software to run your PHP scripts (web sites) both in local development or in production environment.

Zend server is shipped in commercial and community editions. The community edition is available for free. The commercial edition ranges from €1,195.00 to €3,195² for a yearly subscription based on the level of support required (Silver, Gold or Platinum).

The community or the base package is shipped with free Zend software, while the commercial edition has additional monitoring and analysis tools. The base package includes the following:

² Prices were obtained from <http://shop.zend.com/eu/zend-server.htm> and are true at the time of retrieval

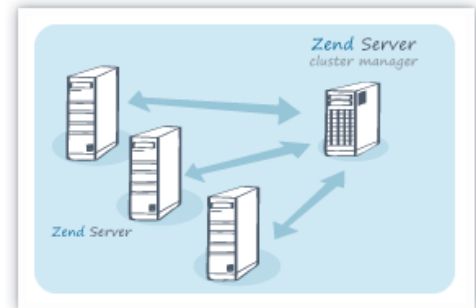
- *Bytecode accelerator (Optimizer+)*
- *Zend Data Cache*
- *A certified PHP distribution*
- *Zend Framework*
- *Apache (or IIS integration)*
- *MySQL (on Windows and Mac OS X only)*
- *Out-of-the-box connectivity to all common databases*
- *Java code connectivity*
- *Web-based PHP administrator console*

(25)

Zend server provides a password protected online interface that can be used to reconfigure the PHP environment, monitor the server and much more.

The commercial edition adds additional features to the online interface of Zend Server. The additional features are related to simplified and enhanced development and also useful monitoring tools:

- Clustering Support with Zend Server Cluster Manager. Clustering enables administrators to make the solution highly available and scalable by deploying several instances of Zend Server and spreading the load between them. While the Cluster Managers allows IT teams to monitor and manage the instances of Zend Server.
- Page Caching. Zend Server UI has an option to enter simple rules that would describe what pages to cache and under what conditions and for how long.
- Application Monitoring. Zend Server automatically monitors for issues in your PHP scripts and alerts you. Zend server can detect such problems as slow executing scripts, PHP errors, excess memory usage, etc.



Recent Events

Id	Generated by Rule	Count	Last Occ.	Severity	Origin
000018	Job Execution Error	53	13-Jan 15:00	Critical	http://localhost/drupal
000020	Job Execution Error	53	13-Jan 08:00	Critical	http://localhost/drupal
000027	Severe Slow Request Execution (Absolute)	2	07-Jan 21:48	Critical	http://vm-php-demo.zend.net/blog/wp-admin/inc
000026	Severe Slow Request Execution (Absolute)	2	07-Jan 21:48	Critical	http://vm-php-demo.zend.net/blog/wp-admin/inc
000028	Severe Slow Request Execution (Absolute)	2	07-Jan 21:48	Critical	http://vm-php-demo.zend.net/blog/wp-admin/inc

Figure 13. List of problems in Zend Server UI.

- Code Tracing. Zend server allows you to trace the execution of code in production and analyse it. This a great tool when you are trying to solve a problem or identify bottlenecks in production.

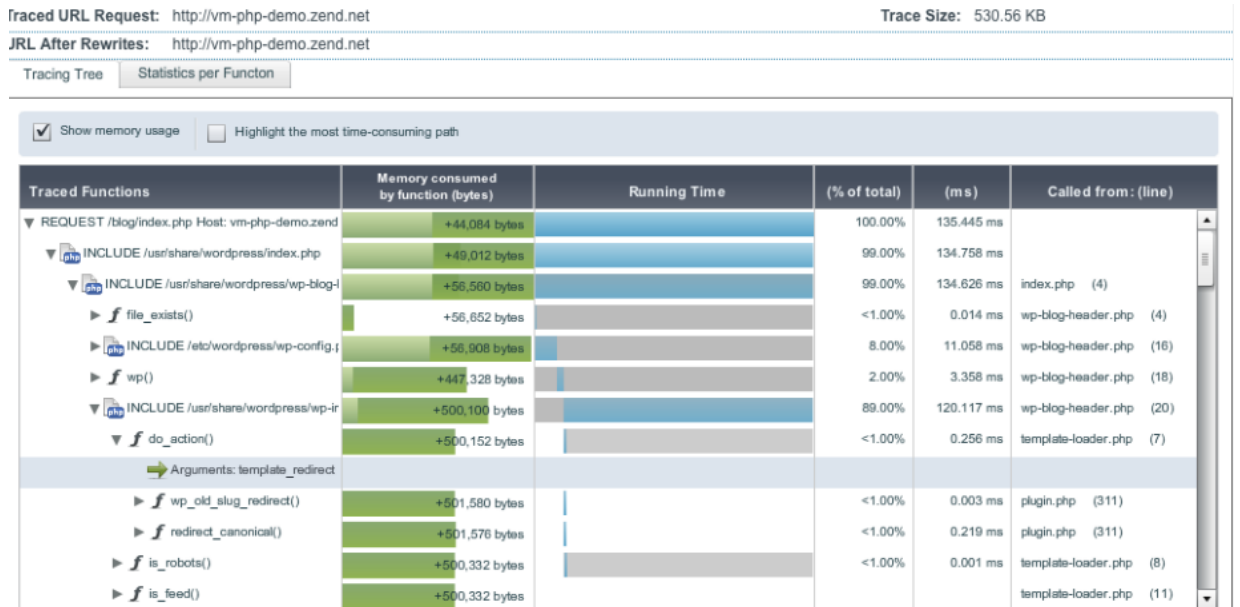


Figure 14. Code Tracing Facility in Zend Server

- Job Queue.

Zend server provides a tool that allows administrators to run scripts offline as jobs that can be scheduled based on time, load and prioritise jobs. The executing of jobs can be monitored and analysed.

Zend server web UI provides means to manipulate jobs and administer them.

Zend server is a very good platform that will help you set up the full stack of PHP applications, services and utilities in a very short period of time and requires almost none or very little configuration.

Zend Cloud Platform

Zend Company in cooperation with Amazon EC2 (Elastic Compute Cloud) offer a platform solution that gives you access to Zend Server with all of its services and tools inside an elastic, scalable and flexible cloud. The cloud platform is especially designed for business critical applications that need to scale often both up and down depending on the load.

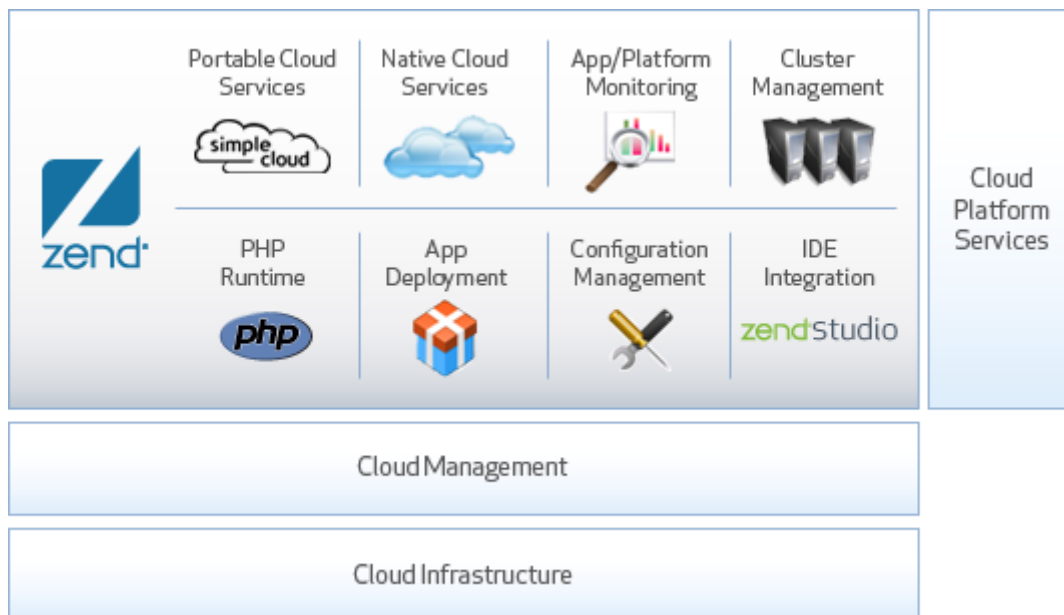


Figure 15. Zend Cloud Platform (26).

Amazon EC2 provides resizable compute capacity in the cloud. You will get access to virtual instances on servers that run identical software stacks (Zend Server & chosen OS). Then, you will be able to upload your scripts to those servers and run as many or as little servers that you require at any given time with an ability to scale up or down within minutes.

Amazon EC2 provides server images with PHP 5.2 and 5.3 running on Ubuntu Linux 10.4 LTS (Long Term Support) 32 and 64 bit versions. These images can be installed on virtual machines in the cloud that come with different hardware specifications. Each running instance is billed per hour, and you only pay for what you use. For example, a small (default) instance running in Amazon's Dublin data centre will only cost \$0.095 per hour. The full list of prices is available here <http://aws.amazon.com/ec2/>.

Such low prices make Amazon cloud a very attractive platform to run your applications. Apart from offering great flexibility and scalability, Amazon Cloud also frees companies from the need to buy hardware, worry about software configuration, repair, maintenance and a lot of other factors that are involved with running your own hardware in onsite or offsite data centre.

Zend Guard

I have mentioned earlier that PHP programs cannot be shipped in form of a compiled executable because the language comes without a compiler. The only way to distribute a program written in PHP is to ship its entire source code.

To protect the intellectual property and to prevent unauthorised modification of your software, Zend offers a source code obfuscation and encryption tool called Zend Guard. There is no free community version available for Zend Guard as with other Zend tools. It comes at a price of €600 per licence.

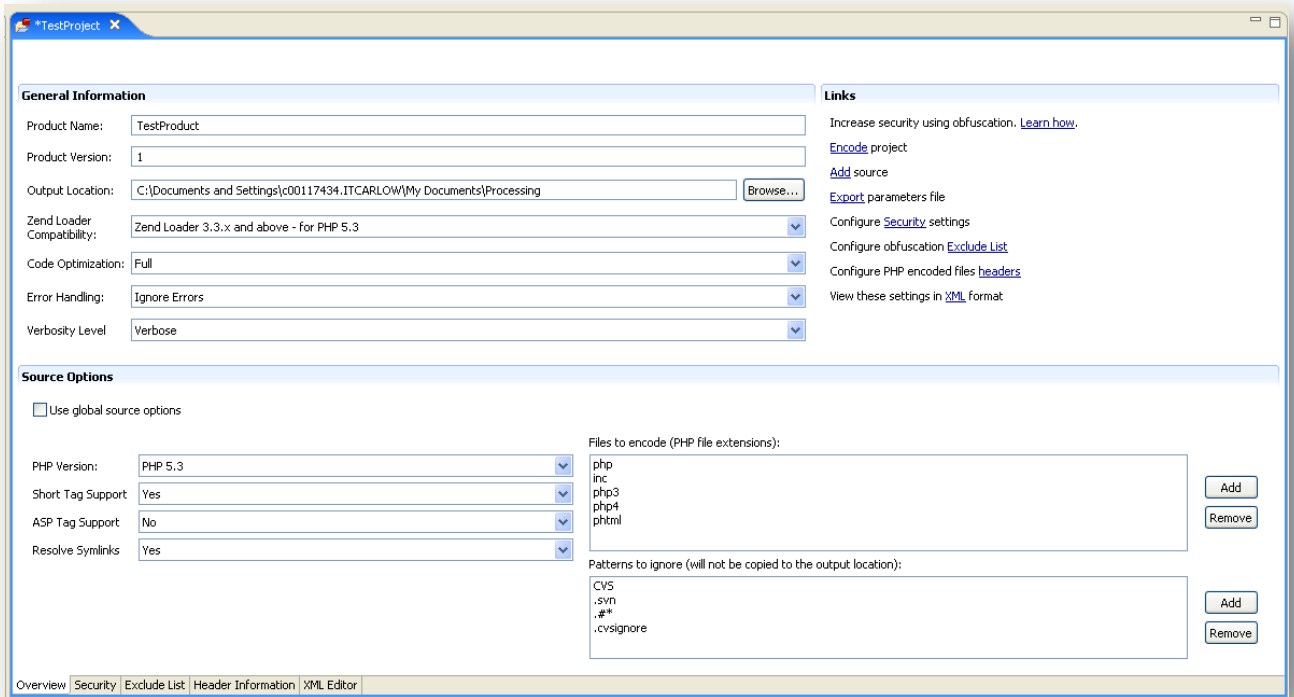


Figure 16. Zend Guard main screen.

When Zend Guard is given a series of source files to encode, it produces the same number of source files, except the source code is turned into encrypted obfuscated text. Zend also ships Zend Guard Loader which is a PHP module that decrypts the code at run time before the interpreter starts its job.

Zend Guard not only encrypts the source code but also has features to enable the encrypted software to expire after a given number of days or to require a valid generated licence (figure 17). These two features are very useful as they allow distributing the encoded software and managing its licenses at the same time. Zend Guard command line interface can be used to automate these tasks.

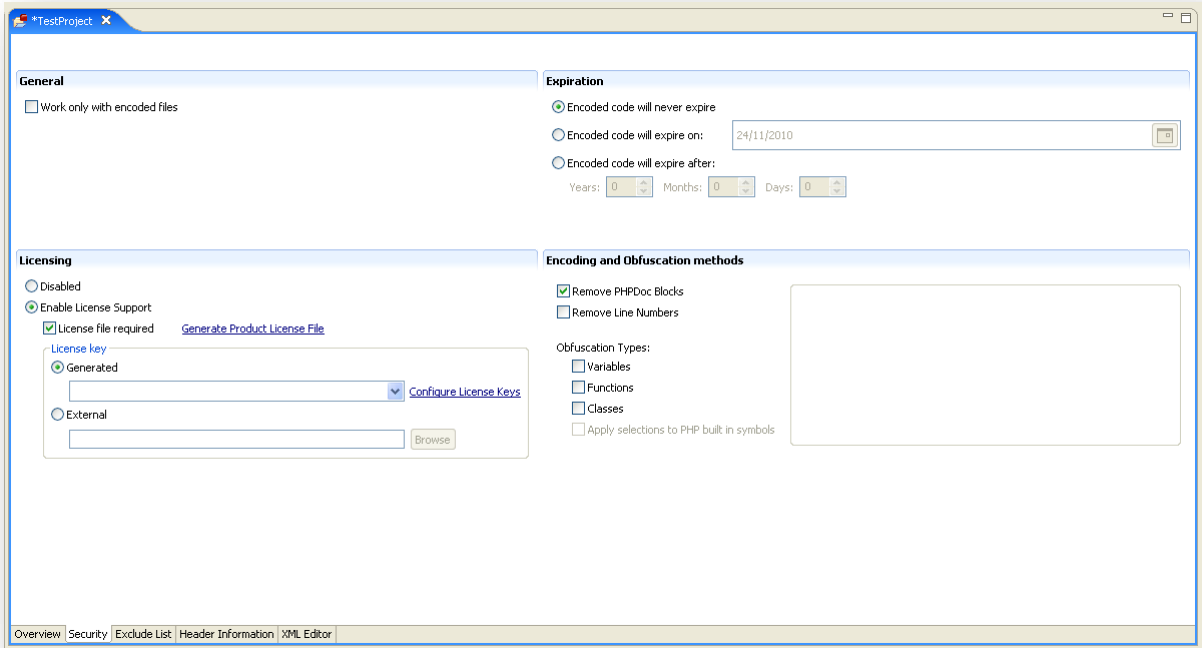


Figure 17. License configuration and security

Zend Guard is not the only encoder available for PHP. There are several other encoders which are also of very good quality such as IonCube which I have personally used in numerous projects.

Aptana



Aptana (<http://aptana.com/>) is another great free open source IDE built on eclipse. It ships with PDT (PHP Development Tools) provided by Zend but makes very significant improvements in other areas of web development.

The current version of Aptana is 2.0, and 3.0 public beta is also available which brings a lot of improvements and support for additional programming languages such as Python and Ruby. Aptana, as it's based on Eclipse, is a cross-platform IDE available for Windows, Mac and Linux.

Aptana comes with a great HTML and CSS editor that provides great hints for elements of those languages and how they are supported in different browsers.

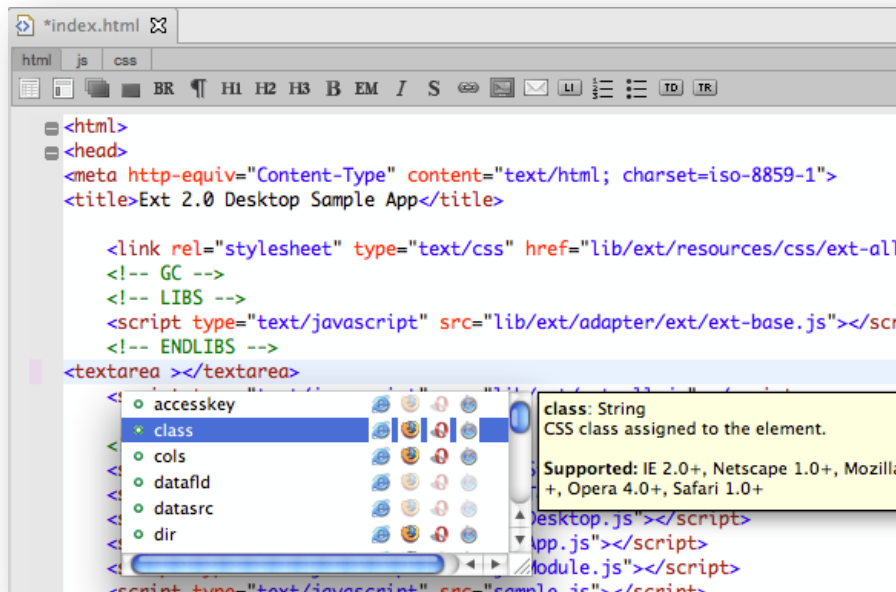


Figure 18. HTML hints associated with browsers

Aptana also provides elegant support, hints and auto completion for the most popular JavaScript libraries such as jQuery, prototype, scriptaculous, Ext JS and more (27). Aptana ships with a built-in JavaScript debugger.

Aptana supports remote file transfer and synchronisation, a rare feature in IDEs, that allows you to synchronise your files with the files on a remote server via FTP and SSH. It is a very useful tool for quick and simple deployments as deployment is a major and often activity in web development. A lot of files need to be uploaded on regular bases. The synchronisation tool helps to avoid using 3rd party FTP tools that usually require you to upload the whole project, and instead it only uploads the files that were modified since the last synchronisation.

NetBeans



NetBeans is an open source and free IDE that is developed by the open source community and backed up by Sun (Oracle, should I say). It is a highly reputable and widely used IDE that is accepted as a market standard for such a widespread language as Java. It supports the majority of popular languages such as Java, C/C++, JavaScript, Ruby, and of course, PHP.

NetBeans is a great IDE for php. It provides an ability to create PHP projects.

The NetBeans PHP editor offers code templates and generation (Getters and Setters), refactoring (Instant Rename), parameter tooltips, hints and quick fixes (Implement All Abstract Methods), and smart code completion (including bracket completion). Benefit from syntactic and semantic code

highlighting, pop-up documentation, code formatting and folding, and marking of occurrences and exit points (28).

The editor works both with PHP 5.2 and 5.3 and fully supports the newly added features to PHP 5.3 such as namespaces.

The editor “understands” comments and based on them provides code completion (PHP is a dynamically typed language) just as Eclipse based IDEs do.

NetBeans integrates with Zend Framework and Symfony framework providing code completion for both.

NetBeans provides fully featured PHP debugger “Xdebug” with breakpoints, code step through, watches and local variable viewer. A command line debugger is also provided when the output of the program goes to the command line rather than a browser.

NetBeans is shipped with testing frameworks such as PHPUnit and Selenium. You are able to create and run test and view the results inside the IDE.

NetBeans integrates with MySQL database, which is most often used in conjunction with PHP in web development projects, and other popular databases such as PostgreSQL and MS SQL.

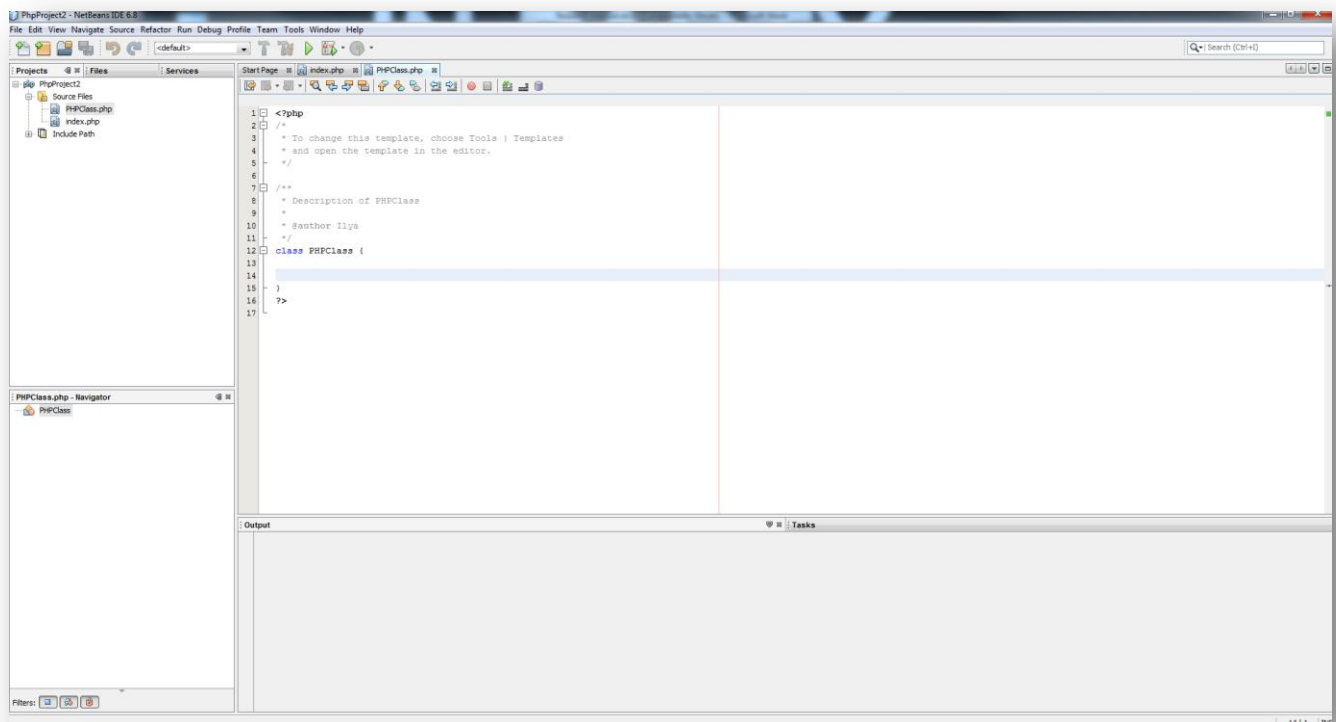


Figure 19. NetBeans IDE main screen.

Frameworks

- *“In computer programming, a software framework is an abstraction in which common code providing generic functionality can be selectively overridden or specialized by user code, thus providing specific functionality. Frameworks are a special case of software libraries in that they are reusable abstractions of code wrapped in a well-defined Application programming interface (API), yet they contain some key distinguishing features that separate them from normal libraries.” (29)*

Zend Framework



Zend Framework is fully object oriented library of commonly used classes in PHP. It is focused on enabling the developer to build a more secure, reliable and modern Web 2.0 applications and web services and consuming widely available APIs from leading vendors like Google, Amazon, Yahoo and Flickr (30).

Zend framework is fully free and open source with a corporate-friendly licensing. It is licensed under the new BSD license and the Zend Framework Licence.³

Zend framework contains a loosely coupled collection of classes. Developers can mix and matches the classes that they wish to use.

Zend framework contains a huge number of components that can be used to develop a web based application. The framework implements the MVC (Model View Controller) pattern which is an industry standard for developing web and desktop based applications. Zend framework ships the following components that are used to implement the MVC:

- *Zend_Application, Zend_Application_Bootstrap, Zend_Application_Module, Zend_Application_Resource*
Classes that create the application itself, its configuration, its bootstrap process and separation of the application into modules.
- *Zend_Controller_Front, Zend_Controller_Action, Zend_Controller_Dispatcher, Zend_Controller_Plugin, Zend_Controller_Router*
These classes deals with the Controller part in MVC. They are responsible for parsing an incoming HTTP request, analysing it, running a necessary controller and then dispatching it back to the user. Controllers can be registered with plug-in that are called when the controller executing logic hits certain stages (pre-dispatch, post-dispatch, etc.)

³ <http://framework.zend.com/license>

- *Zend_Form*
 Zend form component is extremely power and flexible. It allows developers to create HTML forms in PHP code by extending the Zend Form class. Zend Form is shipped with a collection of classes for different types in input fields that a form might have (text input, radio buttons, etc.). So, a zend form can take in any number of elements that it must contain. In turn each element can be provided with a validator and filter which Zend Framework also ships. For example, an element can be provided an email validator instance. When a form is submitted, the validator is executed. If the validation fails, an error will be returned indicating that the form was not completed correctly. On the other hand, filters are classes that filter input data according to certain rules (strip HTML, example). Filters are very useful and important, because the main rule in web development is never to trust any data received from the user because their always a chance that such data can be malicious even if it was not intended to be so by the sender.
 Finally, Zend form can automatically render HTML code for the collection of elements it was supplied. The rendering rules can be amended and customised – zend form implements a highly flexible decorator pattern. A developer can specify wrapper HTML elements that must be used for each element or for a set of elements. However, default rendering rules are usually fine. The output HTML contains classes and identifiers that can be used in CSS to modify the look and feel of the form without going into PHP specifics. In the end, it is really up to a designer to do this job.
- *Zend_Layout, Zend_View, Zend_View_Filter, Zend_View_Helper*
 These classes deal with the View part in MVC. Essentially, they provide a simple template engine. *Zend_Layout* manages the overall template of the web site that is constant among a series of pages. While *Zend_View* manages the bits of code that change inside the template from page to page.

As for the final part of the MVC which is model, Zend Framework ships database connectivity modules and adapters for the most popular databases.

Apart from MVC, Zend framework ships over 50 components that cover virtually any tasks a web developer can face. Zend framework provides modules for user authentication, data caching, currency converters, exception handling, file manipulation, RSS feed manipulation, internationalisation, PDF readers and writers, web mail, data validators and filters, jQuery integration and many more.

CMS - Content Management Systems

There are lot of CMS available that are written in PHP. Joomla and Drupal are two great examples of totally free open source community driver content management systems. They allow developers to quickly create web sites without doing any coding, customise the look and feel and manage content by creating web pages easily. Both CMS are very extensible and with proper knowledge can used to develop great applications.

Both CMS have very active community that provide on-going support and develop extensions (modules). There are a huge number of modules available that are free or low cost to suit any job really.

Python



Overview

- *“Python is a programming language that lets you work more quickly and integrate your systems more effectively. You can learn to use Python and see almost immediate gains in productivity and lower maintenance costs.” (31)*

Python is an object-oriented, interpreted, high level and interactive programming language that is used extensively for web development. There are some differences between Python and PHP. Python is believed to have a more elegant syntax that is often compared to Lisp or Tcl. Python fully support Unicode character encoding which makes it suitable for developing internationalised applications.

Python is fully open source and free developed by the open source community.

Python is a dynamically typed language with modules, classes and exceptions. It runs on Windows, Linux and Mac. There are currently two stable branches in production – Python 2.7.x and Python 3.1.x. A lot of features introduced in Python 3 are not backward compatible. So, the choice of the language version must be made carefully because it will determine what third party libraries will be available for use.

Features

Python is a general purpose language. Even though, it is extensively used for web development, it is also suitable for development of desktop applications. There are a lot of libraries and custom implementations of Python available that allows developers to create desktop applications for different platforms (32). For example, IronPython is a custom implementation that runs on .NET framework in Windows and on Mono framework in Linux. JPython is another custom implementation that tightly integrates with Java and uses Swing UI framework to render desktop user interfaces.

Python’s syntax differs greatly from that of PHP. Instead of curly brackets it uses indentations. New blocks of code are denoted by a colon.

Sample 8-Queens Problem (33)

```
BOARD_SIZE = 8
```

```

class BailOut(Exception):
    pass

def validate(queens):
    left = right = col = queens[-1]
    for r in reversed(queens[:-1]):
        left, right = left-1, right+1
        if r in (left, col, right):
            raise BailOut

def add_queen(queens):
    for i in range(BOARD_SIZE):
        test_queens = queens + [i]
        try:
            validate(test_queens)
            if len(test_queens) == BOARD_SIZE:
                return test_queens
            else:
                return add_queen(test_queens)
        except BailOut:
            pass
    raise BailOut

queens = add_queen([])
print queens
print "\n".join(". " * q + "Q " + ". " * (BOARD_SIZE-q-1) for q in queens)

```

Python can be configured to run under Apache on all platforms (Windows, Linux and Mac OS). It can run both in Fast CGI mode and as Apache module with the help of mod_python module. The advantages and disadvantages of Fast CGI versus a module are exactly same as with PHP.

Python can also be configured to run under IIS (Internet Information Services) on Windows platform. As it is the case with PHP, Python can only run in Fast CGI mode under IIS.

Environment and Tools

PyDev



Python has a number of integrated development environments available. The most advanced of them would be PyDev⁴ build on Eclipse platform. It has all the features you would expect an IDE to have: code completion, code templates, refactoring, and debugger with remote debugging support.

PyDev also provides integration with Django – a popular Python Framework that is used for web development and implements MVC pattern.

PyDev in fact is an Eclipse module that can be installed on any Eclipse derived IDE. The current version 1.6.3 of PyDev is in fact shipped as a part of Aptana studio 2 and 3. PyDev is both free and open source.

⁴ <http://pydev.org/>

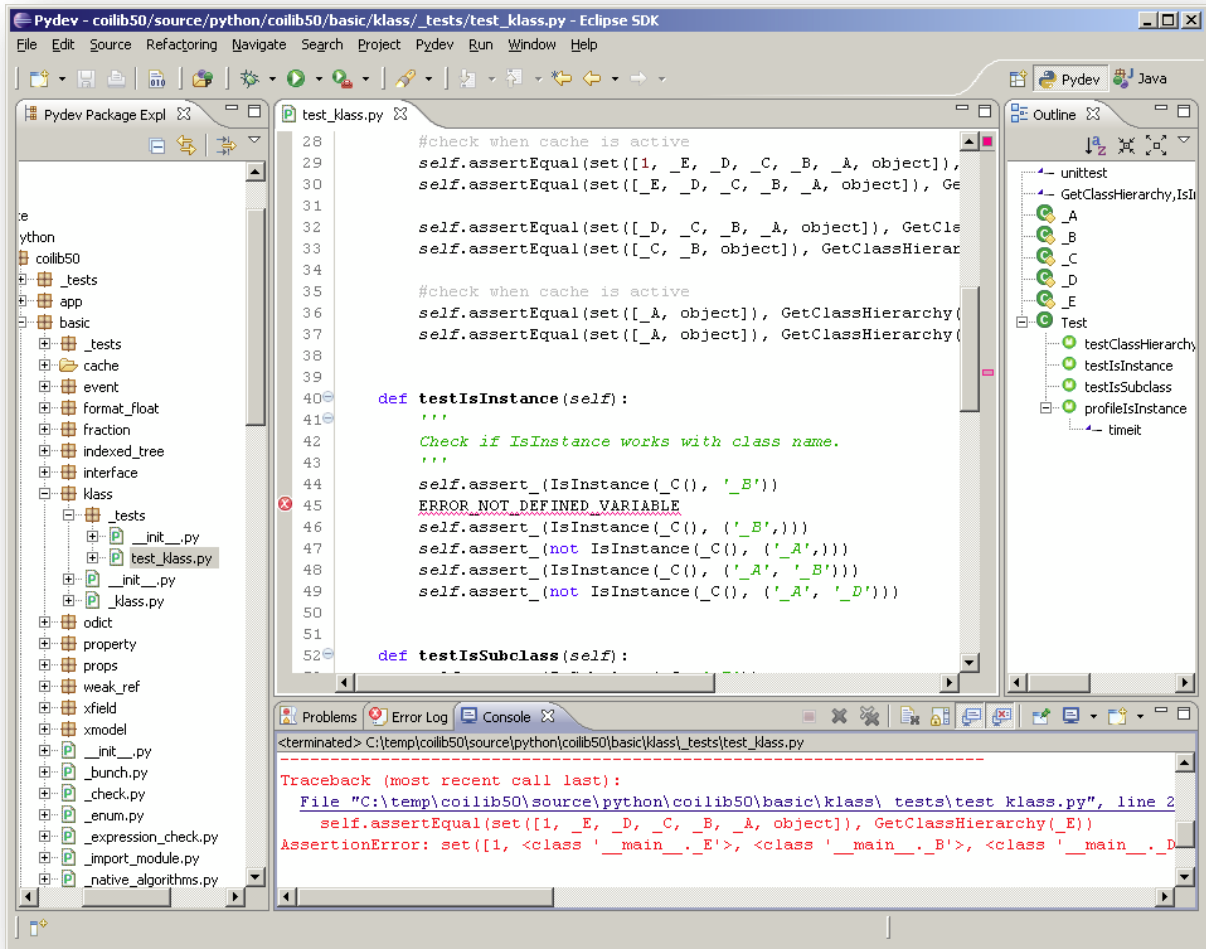


Figure 20. PyDev IDE view.

<http://pydev.org/images/screenshot/screenshot0.png>

Komodo Edit

Komodo is another IDE that supports Python. It comes in two versions: Komodo Edit - free edition and Komodo IDE – commercial edition with an extended set of features.

Komodo Edit is free and open source. It provides support for the majority of popular programming languages such as PHP, Ruby, JavaScript, HTML, CSS and includes Python. It provides basic features such as code completion, ability to organise files into projects, macros and code snippets.

Komodo IDE on the other hand provides a fully featured debugger, integration with source control utilities such as Subversion and GIT. It features a database explorer with support for the majority of SQL databases.

Google App Engine

Google App Engine – a popular cloud platform developed by Google supports Python. Users can upload their web site scripts directly to the cloud which will manage the scalability and load automatically. A clear advantage of App Engine is that it is free once your usage of resources stays

below the certain limit. However, if the application goes over the limit, Google will charge small fee for each of the resources you use: Blobstore, Datastore, CPU Time, image manipulation, mail, memcache, bandwidth and HTTP requests, task queue, etc. (34).

App engine is ideal for projects with small budgets. However, one down side of using the Google cloud platform is that it requires the software to be developed in a particular way. For example, instead of storing files on to a hard disk (which is not permitted), the cloud enforces a usage of blobstore API. This reduces the portability of the application and requires extra work to create a layer of abstract APIs that would overcome this issue. This limitation can lead to a so called “Vendor lock-in” where it is very difficult to switch the service provider.

django

- *“Django is a high-level Python Web framework that encourages rapid development and clean, pragmatic design.” (35)*

Django is web framework that implements MVC (Model View Controller) pattern. Django as Zend Framework ships a collection of components that can be used and extended to quickly develop web based software.

Django is free and open source. It is developed and supported by the open source community.

Django models feature an Object-relational mapper that maps directly to an SQL table in a database. It features transparent persistence of objects and easy object retrieval.

Django has a built in template engine with View management. The template engine is a Smarty like template that allows designers to set variables inside HTML and the developers populate those variables from the View classes.

Django ships a form management component that allows developers to create forms with elements inside Python classes, assign validators to those elements and automatically render forms.

Apart from MVC, Django features a rich collection of components such as Authentication, cache system, security and cross site forgery protection, email server, Internationalisation, pagination support for data, sessions, sitemaps and many more (36).

One feature of Django that deserves special attention is automatic generation of admin panels. Django can quickly create an admin panel that is password protected and allows you to edit your content. Django manages HTML generation, data processing and persistence. The generated admin panel is easily customisable and extendable.

Content Management Systems

Unfortunately, unlike with PHP, Python doesn't have many CMS to choose from. Apart from the lack of quantity, there is also lack of quality, features, and community support in existing CMS.

Skeletonz⁵ is a free open source CMS written in Python. It is very simple but provides a limited number of features. It provides a simple admin interface where one can create new pages and edit existing look and feel templates.

The main downside, however, is that it lacks a community of contributors. Something that each CMS must have – people who use it, support it, and extend it.

⁵ <http://orangoo.com/skeletonz/>

C# & .NET

Overview

- *“C# is a type-safe, object-oriented language that is simple yet powerful, allowing programmers to build a breadth of applications. Combined with the .NET Framework, Visual C# 2008 enables the creation of Windows applications, Web services, database tools, components, controls, and more.” (37)*
- *“C# (pronounced "see sharp") is a multi-paradigm programming language encompassing imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming disciplines. It was developed by Microsoft within the .NET initiative and later approved as a standard by Ecma (ECMA-334) (38) and ISO (ISO/IEC 23270) (39). C# is one of the programming languages designed for the Common Language Infrastructure.” (40)*



Microsoft®
.NET



C# is a general-purpose programming language developed by Microsoft. It is a proprietary language with open specification that can be used to port the language to any platform.

C# runs inside .NET framework which contains so called Common Language Runtime (CLR). .Net provides an abstraction layer over the operating system and can house any language compatible with .NET to run inside it. This allows programs written in different languages to cooperate transparently by using each other libraries in binary forms. They don't need to be programmed in any particular way to work together. So a library written in VB or C++ that was compiled inside .NET can be easily consumed by a C# program.

C# is a compiled language. However, unlike C++ which compiles directly to binary code, C# compiles to a Common Intermediate Language (CIL), just like other languages that target .NET platform. CIL is the lowest level human-readable assembly programming language defined by CLI (Common Language infrastructure). When a request for execution comes in, Just in Time Compiler (JIT) reads the CIL code, compiles it, with the current platform in mind, and executes it.

The fact that C# compiles to CIL makes it considerably more difficult to reverse engineer the code. However, CIL is human readable and even object-oriented. So it simply provides a level of obfuscation, a degree of difficulty.

C# as the language is free. The compiler is available for download. However, the Windows Server platform, IDE and other tools are commercial.

Features

C# can run on multiple platforms. On Windows it runs inside .NET framework under IIS web server. There is also Mono platform available that provides a free open source implementation of C# compiler and the environment for Windows, Linux and Mac OS. You can run C# Mono web sites under Apache web server with mod_mono module. While Mono provides an implementation for most of the components inside .NET, there are some features missing from .NET 3.0 and .NET 4.0. For example WPF (Windows Presentation Foundation) is not implemented in Mono and there are no plans to implement it. The absence of WPF does not affect web development, as it is only used for desktop user interfaces. However, Mono lacks EntityFrameworks support from .NET 4.0 which is an easy implementation of database table entities in C# code. In all cases, there are substitutes available for missing components that are just as good. However, if there is a plan to migrate to Mono at some time in future from Microsoft's implementation of .NET, developers must study Mono and make sure that all the components in use are available on Mono.

Visual Studio



Visual Studio is an IDE created by Microsoft that supports the majority of languages which target the .NET platform: C#, C++, VB.NET. Visual studio can be used to develop web and desktop applications. The latest version of Visual Studio is Visual Studio 2010.

Visual Studio comes in several editions that provide a different range of features and differ in price. A free version is available called Visual Studio Express (figure 18). Unlike commercial editions, free editions are shipped separately for each target platform. There is one for web, Windows, phone and database development. The commercial edition integrates all of the above features inside one single IDE.

Visual Studio Web Developer Express offers limited features for development compared to the full commercial edition:

- *No IDE support for databases other than SQL Server Express and Microsoft Access*
- *No support for Web Applications with ASP.NET (this can instead be done with Visual Web Developer Express, though the non-Express version of Visual Studio allows both web and windows applications from the same IDE)*
- *No support for developing for mobile devices (no templates or emulator)*
- *No Crystal Reports*
- *Fewer project templates (e.g. Windows services template, Excel Workbook template)*
- *Limited options for debugging and breakpoints*
- *No support for creating Windows Services (Can be gained through download of a project template)*
- *No support for OpenMP*
- *Limited deployment options for finished programs*

(41)

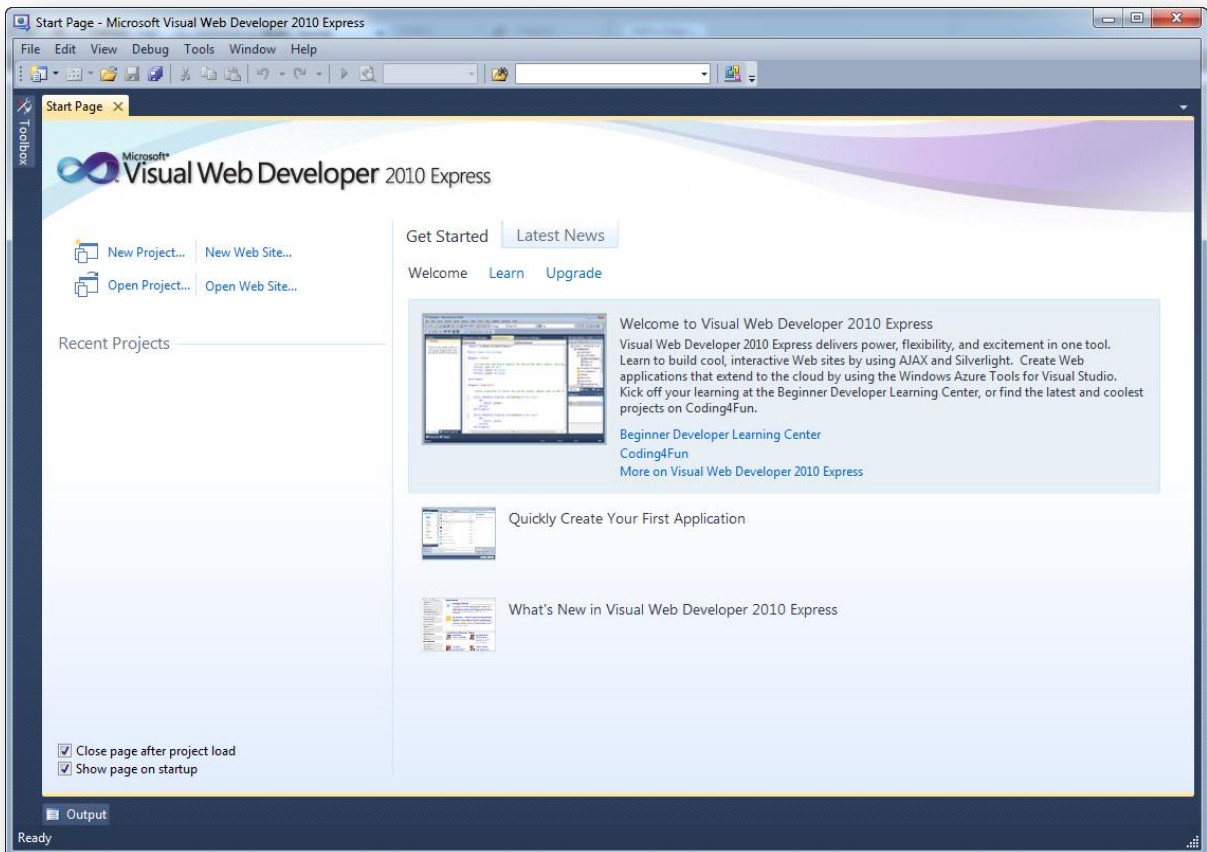


Figure 21. Visual Studio Web Developer 2010 Express. Free Edition

Commercial Visual Studio is also available in several editions: Professional, Premium, Ultimate and Test Professional – specialised for quality assurance teams. They have different level of features that mostly differ in debugging tools, testing tools and architectural modelling.⁶

Depending on the version and MSDN (Microsoft Developer Network) subscription, Visual Studio prices range from under a thousand euro to over 10 thousand per license.

Visual studio is a very advanced IDE. It features a very convenient code editor with smart intellisense (code completion), powerful refactoring tools, debugger with ability for live-debugging of a running application with code step through, watches, breakpoints, local variables view and remote debugging through a VMware virtual machine. Visual studio tightly integrates with Microsoft Team Server that provides tools which simplify development in teams of any size. Visual studio supports visual web development where designers can build web pages by simple drag and drop along with a powerful HTML, CSS and JavaScript code editor. Visual Studio also ships a powerful database development tools that integrate with MS SQL server and allow developers to create databases and tables and run SQL queries against them.

⁶ Full list of features available here <http://www.microsoft.com/visualstudio/en-gb/products>

Team Server

- *“Microsoft Visual Studio Team Foundation Server 2010 (TFS) is the collaboration platform at the core of Microsoft’s application lifecycle management (ALM) solution. Team Foundation Server 2010 automates the software delivery process and gives you the tools you need to effectively manage software development projects throughout the IT life cycle.” (42)*

Team Foundation server is a commercial tool available from Microsoft that helps teams develop better software. It provides the following features:

- Source code management and versioning through a central code repository with an ability to check in and check out code and view the history.
- Bug tracking database
- Build automation that can be event triggered
- Reporting of quality and project progress
- Project management tools

Team server integrates with Visual Studio and creates one unified environment for development. Team server is available for \$499⁷.

MonoDevelop



- *“MonoDevelop is an IDE primarily designed for C# and other .NET languages. MonoDevelop enables developers to quickly write desktop and ASP.NET Web applications on Linux, Windows and Mac OSX. MonoDevelop makes it easy for developers to port .NET applications created with Visual Studio to Linux and to maintain a single code base for all platforms.” (43)*

MonoDevelop is a free open source multi-platform IDE available from Mono Project. It provides an advance source code editor with support for C# code templates, code folding and auto completion. It integrates with ASP.NET framework which allows developers to create web sites in .NET and C#. However, unlike Visual Studio it lacks a visual development environment for ASP.NET.

Apart from MonoDevelop, Mono Project also ships MonoTools – a plug-in for Visual Studio. MonoTools allow developers to scan for Mono compatibility of any project inside Visual Studio and also run and debug it locally. MonoTools is a commercial project and available for \$249 (enterprise edition)⁸.

⁷ <http://www.microsoft.com/visualstudio/en-us/products/2010-editions/team-foundation-server>

⁸ <http://mono-tools.com/store/> - Full range of MonoTools editions

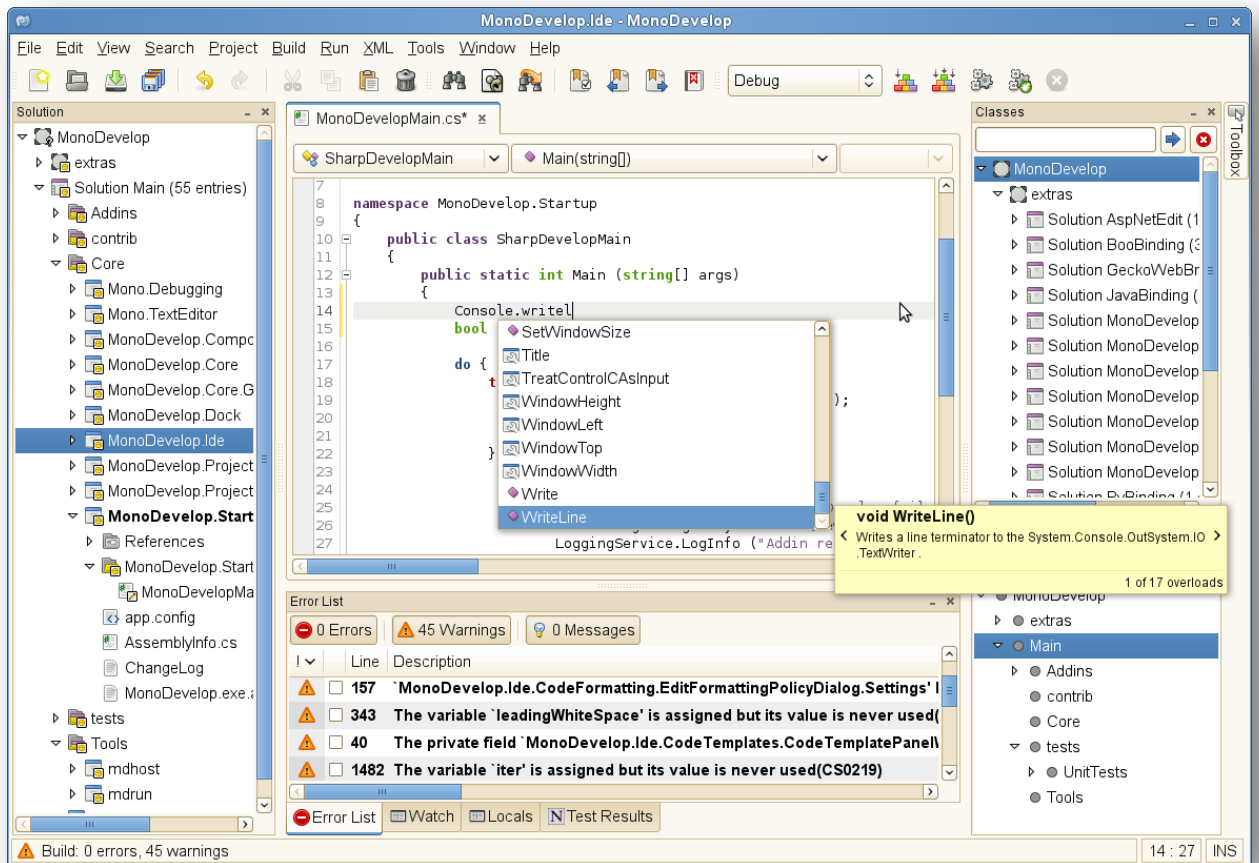


Figure 22. MonoDevelop main screen.

Frameworks

ASP.NET

ASP.NET is a web framework developed by Microsoft to allow programmers build dynamic web sites. It was released in 2002 as a successor to classical ASP (Active Server Pages) (44).

ASP.NET pages are also referred to as web forms. Web forms are placed inside .aspx files and contain HTML code as well as Web Controls and User Controls. Web pages are controlled by a model called "Code-behind". Code behind files are files with C# code that run on the web server, modify and populate the web form template. The code-behind files can run both at page request as well as on a particular page event using Ajax.

ASP.NET features a template engine with master pages that have placeholders where other pages can be rendered in to.

Visual Studio provides a collection of controls that can be simply dragged and dropped on to a page to provide common functionality. This simplifies and speeds the development process.

ASP.NET, however, is not an MVC framework by default, unlike all of the frameworks described above for other languages. In order to make use of MVC in ASP.NET, it is necessary to use the extended ASP.NET.

By default, to allow live communication between the loaded web page in a browser and the code-behind on server-side, ASP.NET web forms injects a lot of JavaScript code into the page to support that functionality. This feature has both advantages and disadvantages. It certainly frees developers from the need to explicitly code Ajax functionality for communication. On the other hand, the amount of code that is injected by default is very big which can slow down your web site considerably and there is no way to avoid it.

Content Management Systems

There are a lot of ASP.NET CMS available that are both free and commercial.

Dot Net Nuke



- *“DotNetNuke is the leading Web Content Management Platform for Microsoft ASP.NET, powering over 600,000 production web sites worldwide. The flexible DotNetNuke platform functions as either a Web CMS or a web application development framework” (45)*

Dot Net Nuke is a CMS and web framework for building dynamic web sites based on .NET framework. Dot Net Nuke is written in VB.NET which did not prevent it from being one the most used CMS online. However, since Dot Net Nuke runs inside .NET platform, it can be extended with any language that targets the platform, like, C# or C++.

Dot Net Nuke is available in several editions. Community edition is free and open source⁹. Professional and enterprise editions are paid version and the pricing is not disclosed, but worked out for each company individually.

Dot Net Nuke comes with the base set of features:

- Content management inside the admin panel that allows administrators to create rich web pages using and Rich text editor.
- Highly Customisable site settings, ranging from UI customisation to users control, logos and skins
- Great number of extensions available that are both free and paid
- File Management
- Simple drag and drop interface
- Internationalisation support
- Social media and social networking built in features

There are several limitations of Dot Net Nuke. It only supports one database which is SQL Server by Microsoft. It is not cross-platform – the code is not optimised to run on Mono.

Dot Net Nuke has a very active community of developers and contributors who provide support and exchange of experiences through the official web forum. Dot Net Nuke also provides commercial support for the CMS with phone and online communication options with the maximum response time as low as 2 business hours.

⁹ Full editions comparison <http://www.dotnetnuke.com/Products/EditionComparison/tabid/1250/Default.aspx>

MojoPortal



- *“MojoPortal is an open source, cross-platform, content management system (CMS) for ASP.NET which is written in C# programming language.” (46)*

MojoPortal is cross-platform CMS. It runs under Windows/IIS or Mono/Apache. Unlike Dot Net Nuke it provides support for the majority of popular databases on the market: MS SQL Server, SQL Azure (Cloud database), MySQL, Postgre SQL, Firebird SQL, and SQLite.

MojoPortal is a feature-rich CMS:

- Custom page creation with HTML WYSIWYG (What You See Is What You Get) such as TinyMCE, FCKeditor or XStandard
- Content versioning with an ability to view the changes made, compare, rollback and see the administrators associated with every change
- Blogs and forums plugins
- Image Gallery
- Template system with a lot of available skins
- Event calendars
- Contact forms
- News letters
- RSS feed integration and social media integration (twitter)
- Flexible menu system
- Configurable user registration process and easy user management through a password protected administration panel
- Built in content widgets from jQuery UI library
- Site statistics and online user tracking

(47)

Databases

- *“A database consists of an organized collection of data for one or more uses, typically in digital form. One way of classifying databases involves the type of their contents, for example: bibliographic, document-text, statistical. Digital databases are managed using database management systems, which store database contents, allowing data creation and maintenance, and search and other access.” (48)*
- Relational Database (Relation database management system or RDBMS) is a database in which data is stored in the form of tables and the relationship among the data is also stored in the form of tables (49).
- *“In computer science, ACID (atomicity, consistency, isolation, durability) is a set of properties that guarantee database transactions are processed reliably” (50)*

MySQL



MySQL is a relational database management system. It is free and open source software originally developed by Swedish company MySQL AB, but now owned by Oracle Corporation. The current stable version of MySQL is 5.1.

MySQL is a very popular choice for web applications and is widely used as a part of a so called LAMP (Linux Apache MySQL PHP) stack. MySQL powers most of the highly used and popular web sites on the Internet: Flickr, Facebook, Wikipedia, Google, Nokia.com and YouTube are among them (51) (52). MySQL's performance and reliability were proven over the years and by the thousands of servers that have this database deployed in production.

MySQL is a cross platform database. It works on Windows, Linux, Mac OS, Sun Solaris and HP-UX. MySQL ships in both 32 and 64 bit versions to support greater file size through longer possible combination of memory addressing.

MySQL ships with a command line that can be used to administer the database and a set of command line utilities that are built for specific purposes, like data backup and restore.

MySQL features an interesting concept of multiple storage engines with InnoDB as default: (MyISAM, Falcon, Merge, Memory (heap), Federated, Archive, CSV, Blackhole, Cluster, Berkeley DB, EXAMPLE, and Maria). Each storage engine has its own unique features that make it suitable for a particular purpose. For example, MyISAM has no support for SQL transactions and low level of

recoverability from crashes which makes it extremely fast. MySQL allows assigning a storage engine to each particular table in a database for improved performance.

MySQL has a rich set of features. Below is a brief list of features that MySQL will provide when used with InnoDB default storage engine:

- MySQL allows stored procedures to be created on the server and executed
- Triggers can be set up to run upon certain events
- Transactions support to ensure that either all statements commit or none
- Full-text search and indexing (Primary key, index and foreign key)
- Powerful and configurable query cache
- Hot backup of a live server

MySQL supports scalability through master-slave replication. In such a case, all write operations are done on master, however, read operations can be performed both on master and slaves.

Furthermore, MySQL provides MySQL cluster database that can be used in conditions that require high throughput. It features an architecture design with no single point of failure which makes the whole cluster highly reliable. MySQL cluster is available in both open source and commercial versions.

MySQL has a range of tools that can be used to administer it. The official tool is called MySQL Workbench. It is an integrated environment for database design and modelling, SQL development and database administration. MySQL workbench is a desktop application that is free, cross-platform. There are also a lot of third party management tools. MyPhpAdmin is a very popular web based tool that is widely deployed by the majority of shared hosting solution providers. It provides a simple web interface that allows you to manage multiple databases, create tables, edit them and execute SQL queries.



- *“SQLite is a software library that implements a self-contained, serverless, zero-configuration, transactional SQL database engine. SQLite is the most widely deployed SQL database engine in the world. The source code for SQLite is in the public domain.” (53)*

SQLite is an ACID-compliant relational database management system which widely used as an embedded database in different software programs due to its extremely small size ~250KB and the fact that the whole database engine is stored in a single cross-platform file.

Firefox browser is among the wide users of SQLite (54).

SQLite comes with a separate command line client that can be used to administer the database.

SQLite is more very suitable for small and local tasks, especially embedding. However, it is not very suitable for usage on the web sites, even though some extreme examples are available. SQLite web site claims that the database will perform fine for small to medium traffic web sites. Even if it is so, the lack of other features would advise against such an undertaking. SQLite has no support for scalability, hot backups and replication. It will be virtually impossible or highly difficult to create a web site that can scale, be reliable and highly available.

SQLite has a series of management tools both free open source and commercial. SQLite3Admin¹⁰ is a free and open source tool written in PHP and very similar to PHPMysqlAdmin. It provides a password protected admin interface that allows managing tables and the records inside them either with the help of GUI or by entering SQL commands.

¹⁰ <http://www.danedesigns.com/sqlite3admin.php>

Microsoft SQL Server



SQL Server is an ACID-compliant relational database management system created by Microsoft. The current version of SQL server is 2008 R2. It runs exclusively on Windows Server platform from Windows Server 2003 an up.

SQL Server comes in a number of editions: Datacentre, Enterprise, Standard, Web, Workgroup and Express. SQL server is also available in Microsoft cloud platform – Azure.¹¹

The express edition is free and comes with a very limited functionality both in features and the hardware it is allowed to run (1 CPU servers with 1 GB of ram maximum and 10 GB of maximum database size). The web edition, however, comes with very high set limits of 4 CPUs per server, no more than 64GB of RAM utilisation and the maximum database size of 524PB.

SQL Server provides a typical model for data storage with data organised in tables with columns where each column must have a data type declared. It provides a great deal of features that highly exceed those of MySQL:

- Combined and computed columns in a table that are derived from other columns
- Highly efficient full text search.
- Various levels of replication: Transaction replication, Merge Replication, Snapshot replication.
- Analysis services that support data mining
- Reporting services that can automatically generate reports from a given set of rules
- Notification services which provide notifications to administrators that are triggered by certain defined events

Commercial editions of SQL Server come with Microsoft SQL Server Management Studio which provides a complete environment to manage SQL servers and their data.

¹¹ Editions comparison <http://www.microsoft.com/sqlserver/en/us/product-info/compare.aspx>

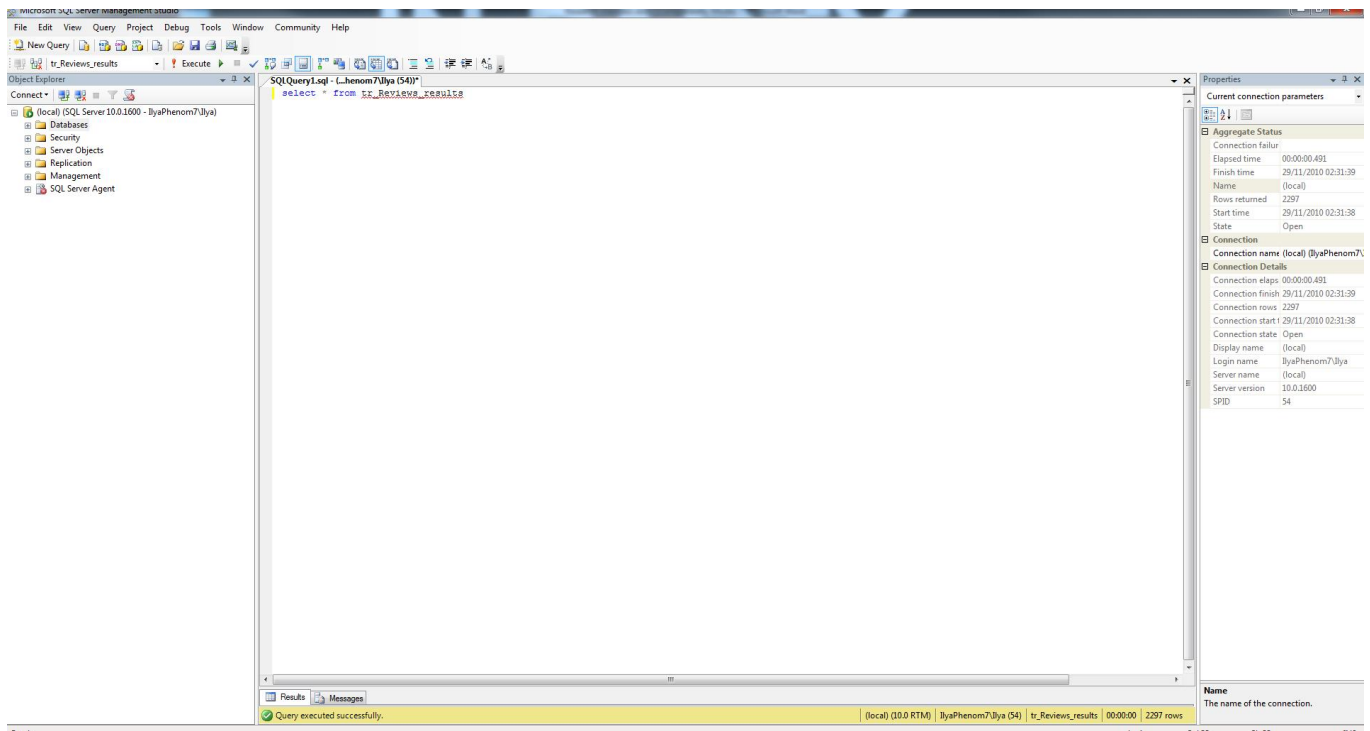
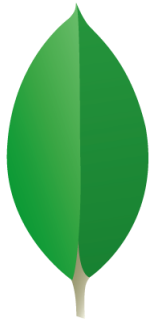


Figure 23. Microsoft SQL Server Management Studio

Commercial editions of visual studio come with built-in integration with SQL Server that allow you to perform the most of the tasks the Server management studio can do.

SQL Server is also available in the cloud on Azure platform. It removes the need to manage the hardware and stay up-to-date with complicated licensing that involves SQL Server. It provides fast provisioning and deployment of new servers, high availability, and scalability according to demand and fault tolerance. SQL azure is very affordable starting only from \$9.99 per month per database for a web edition server up to 1 GB in size or \$49.99 for a database up to 5 GB.¹²

¹² <http://www.microsoft.com/windowsazure/offers/popup/popup.aspx?lang=en&locale=en-US&offer=MS-AZR-0001P>



mongoDB

“MongoDB bridges the gap between key-value stores (which are fast and highly scalable) and traditional RDBMS systems (which provide rich queries and deep functionality).”

“MongoDB is a scalable, high-performance, open source, document-oriented database.” (55)

MongoDB is a database with a different approach than relational databases. It adopts a schema-less table structure, where the columns in a table do not need to be predefined or given type, before they can be populated. Instead, MongoDB manages that itself as it starts receiving data, hence, the document-oriented concept.

MongoDB features JSON-style documents. JSON is (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate. JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and many others. These properties make JSON an ideal data-interchange language. (56) So any data that put into a table or retrieved from a table will be in a form of a JSON object.

MongoDB offers a full index support where a developer can specify a column to index. The search for data is performed with specification of knows pairs of columns and data in JSON format.

The main advantage of MongoDB over tradition relational databases is that it is highly scalable. MongoDB offers auto sharding functionality that can scale the entire database to thousands of physical nodes (servers) and each node can have any degree of replication (slaves). This feature overcomes the traditional bottleneck that all relational databases face sooner or later if the load and data flow is high enough because tables in relational databases cannot be split among a number of servers like in MongoDB.

MongoDB is also incredibly fast. It can perform up to 80 thousand insert operations per second or 100 thousand of read operations (57).

However, performance and scalability come at price of other features being not available. The main downside of MongoDB is that it is not ACID compliant. It doesn't provide support for transactions. And further, creation of relationships between collections of documents like in traditional relational model is somewhat discouraged because it will have degrading effect on performance as the size of the database and the load grow.

There are a lot of examples of successful use of MongoDB in production. For example, FourSquare, bit.ly, SourceForge, The New York Times, CollegeHumor use it in some of their systems (58).

Mobile Platform Languages

HTML 5 and CSS 3

HTML 5 is a new mark-up language currently in development for the Web. In fact, it's more than just a mark-up language compared to HTML 4 that was released in 1997. The web has evolved greatly since then and HTML 4 simply cannot cope with the modern need for features.

HTML5 is being documented by W3C (WWW Consortium) at present and its specification is in a draft state. The draft is greatly influenced by several browser engines that implement new features and ship them. Web Kit is one of them. It is an open source web browser engine that currently powers Apple Safari and Google Chrome browsers. Gecko is another engine used in Firefox. Both of these engines provide an extension over the traditional HTML 4, CSS2 and somewhat JavaScript. They include a great number of additions and improvements that help developers solve problems without resorting to hacking which became a standard and accepted (if not the only possibly) way of development on the web inside a desktop browser. However, both of these engines take a different approach and are inconsistent with each other in many ways. So, it is necessary to write a script for each of them which greatly increases the work load and complexity of such a task. And then, of course, there is Opera browser that runs its own engine, and Internet Explorer.

Therefore, ideally we would need to wait for HTML5 specification to be fully ready and implemented until we can use its full potential inside web browsers. In the time being, we may utilise some of the features that the majority of modern browsers have implemented and resort to JavaScript and JavaScript libraries for a definite cross-browser support of features.

On the other hand, we should distinguish between desktop browsers and mobile platform browsers. In desktop environment, Internet Explorer dominates the market and sets anti-standards for innovation. While Internet Explorer 9 seems to include quite a lot of HTML5 and CSS3 functionality (59), Microsoft is very slow to promote upgrades among its users to the latest version of the browser especially in the corporate market where IE6 is still widely used. Looking at the mobile platform browsers, we see very little presence of IE and luckily, it is dominated by Web Kit based browsers that set the standard for innovation by such companies and devices as Apple iPhone, Google Android, Nokia, Palm. Together they represent around 65% of the market share, if not more today (60). Web Kit, being one the most innovative mobile engines, allows us to utilise its capabilities in the mobile platform on mobile browsers to bring richer experience to users and eventually, as I personally hope, the mobile market will drive the need for implementation of HTML5 and CSS3 on desktop browsers by showing users what these technologies are only capable of.

New Improved Semantics

HTML5 aims to become a semantically meaningful markup language not only for web developers who read and write the code but also to web browsers and search engines that parse it and extract information from it.

For instance, consider two images below. The first one represents a typical page layout created in HTML4. It is very clear what each div element is for by reading ID and Class attributes. However, to web browsers and search engines these values have absolutely no meaning. Now, consider the second image, which represents a page layout written in HTML5. The tags provide clear division of blocks. Nav tag tells us that we're expecting web site navigation inside. This information is very meaningful to search engines and can be used to provide better search results.



Figure 24. HTML4 document layout. (61)

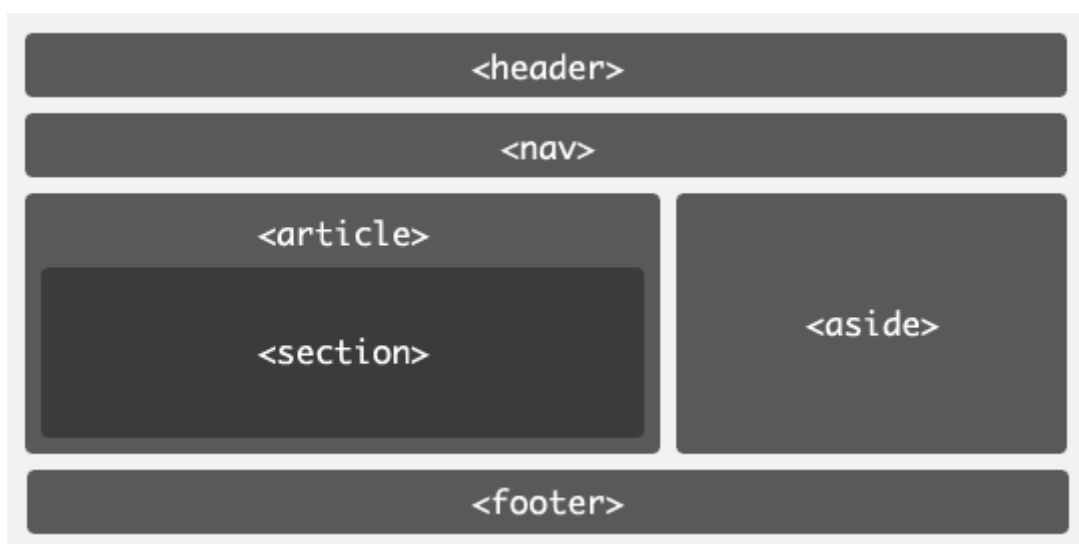


Figure 25. HTML5 Document layout (61)

More interesting results can be obtained if we combine the new layout with the new Microdata format introduced by HTML5. Microdata essentially are a set of classes with properties that are

defined elsewhere and referenced from inside an element by supplying a link to it in a special attribute.

```
<section
  itemscope itemtype="http://data-vocabulary.org/Person">
  <h2 itemprop="name">This is my name</h2>
  
  <p>I work for <span itemprop="affiliation">Info Support</span>
    as a <span itemprop="title">.NET developer</span>.</p>
  <address itemprop="address"
    itemscope itemtype="http://data-vocabulary.org/Address">
    <p itemprop="street-address">This is my street name</p>
    <p itemprop="locality">This is the city where I live</p>
  </address>
</section>
```

Figure 26. HTML5 section with Microdata properties (62)

In the code above we can see a section that provides some information about a person, like a personal card. The section itself is marked to be a Person class and a reference is given where the definition of the person class can be found along with all of its properties.¹³ The nested tags are marked with properties of the person class. Essentially, this is object oriented programming in HTML. The significance of such markup style is that it is extremely searchable. Furthermore, Microdata formats are nothing more than XML documents that can be created by virtually anyone and referenced.

Applied to mobile platform world, such a personal profile summary can be easily parsed by a browser and allow the user to add the information of that person to their contacts.

¹³ In this case, it is data-vocabulaery.org. It is a Google owned web site that specifies a list of Microdata classes that can be utilised.

CSS3

Fonts

CSS3 provides a new type `@font-face` that solves a very old design problems of using non-standard fonts. It is the uncertainty if a particular font is going to be available on the client's machine given the variety of platforms. CSS3 allows for a URL of the font to be specified and if the target browser does not have it, it will be able to load it from the given location.

Selectors

CSS3 provides a variety of new selectors that help developers select required DOM elements with more flexibility. For example, `nth-child()`, is a new selector that can pick out a child of a particular element, either sequentially or with a predefined constant such as `odd` or `even`.¹⁴

Columns

CSS3 allows text to be easily divided into columns. Developers can specify the number of columns, divider between them and a gap size. In CSS2 developers need to manually format text into different elements which is much more difficult to do and highly inflexible.

Opacity

CSS3 can set an opacity value (from 100% to 0%) on any element be it either text or image. At the moment, the opacity is achieved either with PNG images that support opacity or via JavaScript frameworks.

Rounded corners

CSS3 allows to set a round border on an elements border by supplying a radius value. In traditional CSS2 this was achieved by inserting premade images that were of the same colour as the body of the element in question in to all four corners of the element.

Gradients

CSS3 provides support for colour gradients that can be applied to background and foreground of an element.

Shadows

CSS3 allows setting a drop shadow property for an element and specify its colour and position offset from the element.

¹⁴ <http://www.w3.org/TR/css3-selectors/> - full list of css3 selectors

Custom Data-* Attributes

HTML5 allows to add data-* attributes to any element inside the DOM tree. For example:

```
<section data-owner="User Name">
```

would specify the owner of the section. This feature adds great flexibility to storing data that needs to be associated with an element at run time given the dynamic nature of elements on pages of the modern web sites that can be rearranged and modified to a great extent. Furthermore, the entire section tag can be now serialised and sent to the server where it can be easily processed. In essence, data attributes turn html tags into objects, just like classes in a traditional object oriented languages.

New JS Selectors

Currently, JavaScript provides very limited functionality for searching the DOM tree. It provides several functions that can carry out a search by tag name, tag ID or a name attribute of a tag:

```
<p name="paragraph" id="theID">
```

Quite often, it is necessary to search a collection of elements by its class. New JavaScript provides such a method. As well as a new `querySelectorAll` method that accepts virtually any valid CSS3 selector.

At the moment, these features are implemented only in JavaScript extension libraries such as jQuery and use custom regular expressions to perform such searching which is considerably slower than native function execution.

Web Storage

Web storage is a new function in JavaScript and HTML5. It is a simple key-value storage that is persistent. The data persisted to the web storage of the browser will be available even if a page is closed.

Web storage can be used through a very simple interface that provides two functions:

```
localStorage.setItem(key, value) #persist value to storage under supplied key  
localStorage.getItem(key) #get value from storage with the given key
```

This simple feature has many uses. For example, if we look at Gmail. When you are typing a new email, the Gmail system automatically makes snapshots of your email text and sends them to the server saving them as a draft. So that, if you accidentally close the browser window or if your computer loses power, you will not lose your work. Such a simple feature requires a lot of programming. The client side script needs to send the data to the server at regular intervals, then the server needs to store the current version of text in some sort of a database. This requires hard disk space and bandwidth. Instead, such backups could be stored directly inside the browser and easily restored if needed, or discarded when the email is sent.

Web Workers

JavaScript is a language with sequential code execution and JavaScript is responsible for manipulating the user interface. Imagine a situation where we need to execute a heavy script, do some number crunching and at the same time we need to make updates to the DOM (UI) model. We face a well-known problem where some code is in CPU-starvation mode – it can't start until previous scripts finish executing. And what if they don't finish at all?

HTML5 provides a Web Worker model which is essentially a multi-threaded model inside a browser. Developers can create web workers and execute heavy JavaScript code inside them while leaving the UI responsive and unblocked.

Web Socket

Web sockets are a truly revolutionary addition to HTML5 and JavaScript. It redefines the way Client-Server architecture functions. Web Sockets allow bi-directional and full-duplex communication between the client and the server. Once a connection is established, the server can initiate communication with the client and send it data.

This is very useful in mobile world where the server needs to often notify the user of an occurrence of some event. In our case, the server can notify the client about the outcome of the bid the client placed on a particular job without having to client to regularly check (poll) the application about the results.

Native Drag-n-Drop

HTML5 and JavaScript provide native drag-n-drop functionality. This applies to elements on the page that can be rearranges and moved from a spot to spot. It also applies to files (in Google Chrome browser only, at the moment) that can be dragged from the browser directly on to desktop to save a file, or from desktop to the browser window to upload a file to the web site.

Speech Input

The problem of the speed of data input exists since the rise of computers. We are bound by the speed we can type at. HTML5 provides an API that can be consumed to input data into an input field using speech. The voice data is then sent to Google Speech recognition service where an attempt is made to convert it to text. The text is then returned to the client and inserted into the input field. At the moment, the speech recognition system shows various results from excellent to very poor.

It's a very perspective technology especially in mobile world with small keyboards or small screens that make it rather difficult to input any significant amount of text.

Apple currently uses speech recognition extensively ranging from dialling a contact number to asking the phone to play a song or an artist from the media library. However, they are no efforts made at speech input inside apple platform yet unlike Google Android that features web search through speech.

Audio & Video

HTML5 adds two new tags: Audio and Video. They allow web developers to embed audio and video content and simple playing controls into the web page without use of any 3rd party plugins or technologies such as flash.

This addition is especially useful considering that iPhone doesn't support flash and the majority of the videos available online are in flash format (FLV).

Geolocation

HTML5 and JavaScript provide Geolocation services. With the permission of the user, it is possible to determine their location. The service uses Google Maps under the hood. In the desktop world, the location is determined using the IP address of the user and the Wi-Fi networks available around, so scandalously known, when it was revealed that Google Maps Photo Cars were collecting information about them.

It is easier to determine the exact location of the user on a mobile platform because the majority of modern smart phones come with a built in GPS chip. Otherwise, the nearest cell receivers and surrounding Wi-Fi networks are used to estimate user's location.

Geolocation is especially useful on the mobile platform. It allows developers to deliver location-aware services.

Forms

HTML5 greatly improves forms functionality over HTML4.

Placeholder text

Placeholder text is a string that can be placed into an input field and it is displayed until the moment that fields becomes focused. HTML5 provides a placeholder attribute that can be given the placeholder text value to display.

Autofocus fields

Developers can choose a default input field to autofocus when a page first loads.

New Input Types

HTML4 currently provides several types of input fields: text, password, radio, checkbox, file, select and submit. HTML5 introduces the following input types:

- Search
- Tel – telephone
- URL
- Email
- Datetime
- Date (calendar appears in supported browsers)
- Month
- Week
- Time
- Datetime-local
- Number (plain input, spin box or a slider input).
- Range (a slider, usually)
- Color (colour-picker usually)

Based on these types, mobile browsers without a physical keyboard (like iPhone) can bring up a customised version of the keyboard that is most suitable for the particular input type. For example, in the image below the iPhone brings up a URL input keyboard with .com, dot and forward slash buttons which will most likely be used during the URL input.

Furthermore, given the new input types, we can easier attach validators based on those types. A JavaScript function can simply traverse the form reading the input types and attach appropriate validators to input fields.

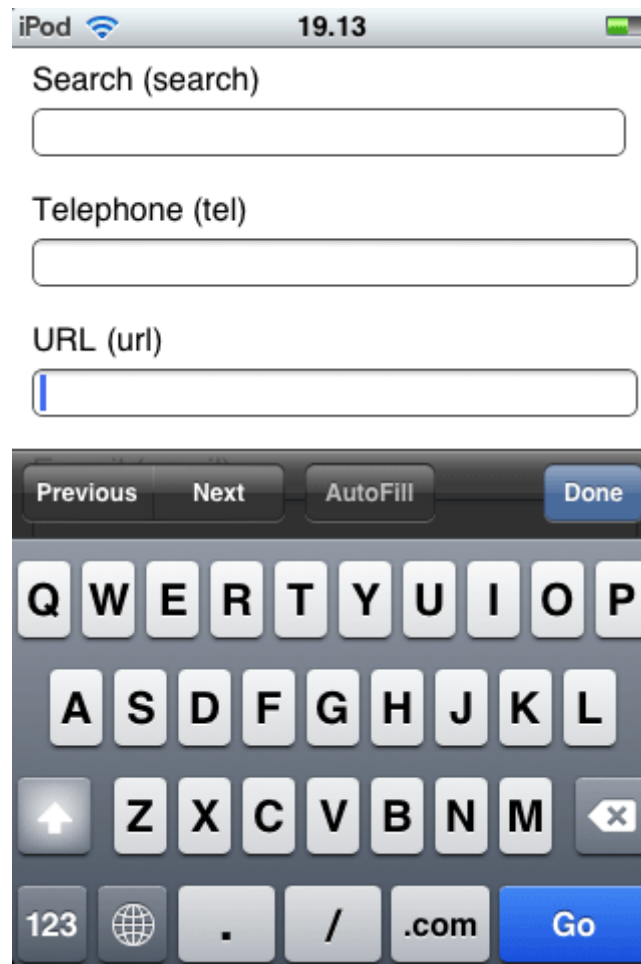


Figure 26. URL input type with customised keyboard

JavaScript Mobile Frameworks

HTML5 provides developers with a great variety of tools. However, in our imperfect world, the browsers support these features to various extents. Mobile browsers have generally greater support for HTML5 than desktop browsers.

JavaScript mobile frameworks attempt to solve this problem by utilising native HTML5 features where they are supported and resorting back to HTML4 & JavaScript when some feature is unavailable.

Furthermore, such frameworks provide a common set of functionality that works the same on any given browsers, including some helper functions, UI elements and event handlers, to name a few.

Sencha

“Sencha Touch is a JavaScript framework for creating Web applications targeted to touch-based devices. With Sencha Touch, you can use the skills you already possess to create an elegant and consistent user experience with minimal effort. Sencha Touch makes use of technologies such as HTML and CSS to provide native-quality application experiences without needing plugins.” (63)

Sencha allows you to build html pages for touch based devices by simply including the style sheets and JavaScript library shipped by Sencha. Currently, Sencha provides Android and iOS platform support. However, Sencha utilises the Web Kit framework that is used in the majority of other mobile browsers such as Blackberry and MeeGo.

Sencha Touch provides the following UI features:

- Buttons. Native looking buttons fully created in CSS3
- Forms. All input types described above are supported by Sencha. It will provide native UI for form input where possible (text, email, URL, etc.) or render custom input using JavaScript (dates, for example)
- Lists. Sencha allows developers to build native looking lists with alphabet access like in iPhone
- Icons. Sencha ships a collection of standard icons (settings, favourites, etc.) which can be given a badge text (just like Mail icon on iPhone with the number of unread emails). All features are created using CSS3.
- Toolbars that can be applied to header or footer and given buttons
- Carrousel control that can be used to scroll through content, like pictures.
- Tabs
- Map control (Google Maps)
- Overlay controls

Sencha also ships a number of events handlers and CSS3 effects:

- Orientation change event handler
- Tap and double tap handlers
- Scroll
- Swipe
- Pinch

- CSS3 transitions:
 - Flip
 - Fade
 - Cube
 - Pop
 - Slide

Sencha Touch also provides elements for layout management that can automatically adjust to screen size and orientation given some configuration is provided. Sencha ships with a rich set of tools that support ajax communication, HTML5session storage, XML readers and Writers and many more.

Phone Gap

- *“PhoneGap is an open source development framework for building cross-platform mobile apps. Build apps in HTML and JavaScript and still take advantage of core features in iPhone/iPod touch, iPad, Google Android, Palm, Symbian and Blackberry SDKs.”* (64)

Phone Gap supports the following native features that can be accessed via JavaScript:

- Geo Location – provides access to the GPS sensor on the device
- Vibration
- Accelerometer – captures device motion in 3D space
- Sound
- Camera – provides access to device’s default camera application
- Contacts – provides access to the database of contacts on the device
- Device – provides information about the current device: name, version, platform, etc
- Files – provides access to device’s file system for the purpose of reading and writing files
- Network – provides access to the device’s cellular and wifi connection information
- Notifications – provide visual, audible and tactile device notifications

(65)

JQuery Mobile

- *"A unified user interface system across all popular mobile device platforms, built on the rock-solid jQuery and jQuery UI foundation. Its lightweight code is built with progressive enhancement, and has a flexible, easily themeable design"* (66)

jQuery mobile is a JavaScript framework that is touch optimised for mobile devices. It supports multiple platforms: iOS, Android, BlackBerry, Bada, Windows Phone, Palm webOS, Symbian, Meego (67). It allows developers to write an application once and make it run across all mentioned mobile platforms.

jQuery Mobile is currently in alpha 2 version which means that it significantly change in future releases and might not be suitable for production purposes. However, as announced by John Resig, the creator of jQuery and jQuery Mobile in his blog post, jQuery mobile stable version 1.0 will be released in January 2011 (68).

jQuery mobile provides HTML5 Markup driven configuration. For example, developers can define a set of CSS classes that should be used when the screen of a mobile phone rotates from portrait to landscape.

jQuery mobile uses pages to display information. A page can contain other pages inside itself to provide quick and smooth transition between those pages (just like in the old WML - Wireless Markup Language for WAP). However, smooth UI transition to external pages is also possible. jQuery mobile parses all URLs on the page and when a link is clicked it, in fact, displays a loading spinning circle while downloading the requested page via Ajax. Furthermore, a page can be presented using modal dialog.

jQuery mobile supports theming through a use of a new object-oriented CSS3 framework that can be used to apply styles to individual elements on the page, or modify all elements across all pages.

jQuery mobile ships with a number of prebuilt widgets:

- Buttons – allow application to be interactive by accepting user clicks. Button can be of different shape and form, have icons built in to them, built in groups according to certain logical grouping
- Toolbars that can be used as headers and footers. Toolbars can be given a title and can have buttons embedded.
- Grid (column) layout manager that allows content to be displayed in columns
- Collapsible content that can be displayed or hidden on click or other event
- Form input elements
 - Text
 - Text area
 - Search input
 - Flip Switch
 - Slider
 - Multiple choice lists
 - Radio choice lists
 - Dropdown select elements

- List views – a collection of unordered items or a list

<http://forum.jquery.com/topic/mobile-events-documentation>

Platform Choice

After I have researched the available web platforms with programming languages, web servers and databases I pick one, which I believe will be the best match for the current project.

My choice would be the popular LAMP (Linux, Apache, MySQL and PHP) stack for several reasons.

First, starting with operating system, I believe that Linux is more suitable for running always-on web applications. It provides great reliability and proven stability. It is highly configurable and fully open source. It frees the administrators from having to deal with a great number of Windows Server editions that have complex licensing agreements and can be very costly. Linux, on the other hand, is a totally free platform that can be installed and configured quickly and easily. Linux is also one of the main choices of web hosting providers. A simple preconfigured ready to go web server can be purchased for a very affordable price that is completely managed and maintained by the hosting company.

Second, Apache is a highly reliable web server that is deployed on millions of web servers. It has a proven track-record of high performance and extreme robustness. Apache is free and open source. It is highly configurable and can be adjusted to any task. One down side of Apache over IIS, however, is that unlike IIS it does not provide a simple GUI interface to manage itself. The administrator has to edit the configuration files directly to make desirable changes to the configuration of the web server. Even though it is a disadvantage, it will not be an unmanageable task. Apache provides very detailed online documentation that explains how to configure the web server. And in reality, configuration needs to be done only once and would rarely need to be amended.

Third, MySQL database is a very reliable database that is used on millions of servers and powers some of the most highly used web sites on the Internet. It comes at no cost, provides free support through its active community or commercial support that is delivered by Oracle. MySQL database is free and open source unlike MS SQL Server that has many editions and complex licensing agreements. MS SQL Server is a great database. However, I believe it would be an overkill to use it in our project. It provides too much functionality that will never be utilised. Therefore, we need a simpler solution that will have fewer features and thus be less complex and more performing. Furthermore, data that is currently in MS SQL Server in production can be easily transferred to MySQL as both servers implement very similar versions of SQL 92 standard. This means that the set of SQL queries that were developed and currently in production can also be used, probably with some modification required. Furthermore, MySQL provides simple scalability features that can be used if needed, namely master-slave replication.

Fourth, PHP is a very popular language that is widely used in most popular web sites on the Internet. PHP has a very active community of developers who can provide support. Furthermore, PHP has a high number of free and commercial tools available that simplify development. Most of the tools come in free and commercial editions. Therefore, we require no costly up-front investments with a possibility to upgrade to commercial editions of tools if we deem it necessary.

Python on the hand can replace PHP in the above model. I agree that it is more elegant but unfortunately it loses the language battle to PHP in all other aspects: community size, amount of high quality open source code and CMS. Furthermore, Python lacks one integrated platform with analytical tools and utilities that Zend provides.

Considering C#, it is a very powerful language, but requires a rigid choice of platform or an in-depth knowledge of cross-platform development with Mono which is really an unnecessary task to perform. C# features a great platform for web development (ASP.NET) and great tools like Visual Studio. However, they all require a considerable up-front investment and provide no real value to us over PHP's free platform.

Finally, the choice of LAMP stack is guided by my personal in-depth knowledge of the platform and a 4 year experience in this field. I am confident that this platform and my experience will allow me to deliver the best product in aspects of quality, security and performance.

Regarding the mobile application I am inclined to choose Sencha Touch framework over jQuery Mobile. Sencha Touch provides much greater functionality and features than jQuery Mobile. Even though Sencha only provides support for two platforms, iOS and Android, it does so very well. iOS and Android on the other hand are the leading mobile platforms on the market. Limited support can be viewed as an advantage. Furthermore, Sencha Touch targets Web Kit based browsers which are the leading browsers with the best HTML5 support. JQuery Mobile, on the other hand, tries to support other browsers too, and it does so by sacrificing the richness of features in order to provide support for the majority of mobile platforms. In fact, if we study the browser support table of jQuery mobile¹⁵, we will see that the best support is provided only for iPhone and Android, while Windows mobile support is marked as low quality, since Internet Explorer Mobile web browser has no HTML5 support at all, no surprises. The only real downside of Sencha as compared to jQuery Mobile is no support for Opera Mini which is a considerably popular browser. Opera mini, even though HTML5-capable is not based on Web Kit framework, and hence has no support for CSS3 functionality that the Web Kit ships.

Sencha Touch is also much more mature than jQuery mobile which is still at Alpha release stage. During my testing of jQuery mobile on iPhone I encountered several bugs that prevented me from navigating to the next page. Furthermore, the navigation itself is done strangely. Instead of simply allowing the browser to go to the next page, jQuery mobile displays a loading message, while issuing an Ajax request and downloading the page in question, and then swapping out the current page with the new page completely. With the way the browsers are designed, I see this as a great opportunity for memory leaks, of course, this is my humble opinion. And finally, I was unhappy about the forms functionality. For example, a select input is handled strangely. Instead of loading all options of the select statement, jQuery Mobile places them on to a different page as a list and navigates to browser away to that page. Once the item is selected, the browser is sent back to the original page and left at the top of it, rather than focusing back on the last input element or the next one.

JQuery mobile is a very promising framework but I do not believe it is production-ready yet.

And lastly PhoneGap is not suitable for the project. What PhoneGap does is it takes an application built in native HTML and CSS3 (one built with Sencha event) and produces a native application for a specified platform. We require the application to run in a browser.

¹⁵ <http://jquerymobile.com/gbs/>

Conclusion

In this research manual I have investigated the available platforms for web development both for desktop and mobile. I documented each technology and tried to keep my research in both worlds: open source and commercial.

I have also done extensive research on HTML5 and CSS3 that helped me to gain better understanding about the future of the web.

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