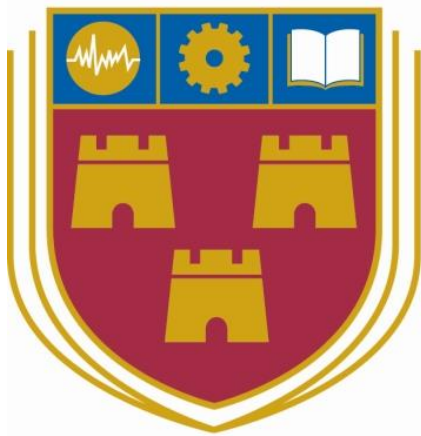# Hashi Puzzle (Islands and Bridges)

Research

Institiúid Teicneolaíochta Cheatharlach

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Contents

Abstract

This is a Research document on a Puzzle game called Hashi (Islands And Bridges), the document describes what hashi is and rules of the game this document covers the research of how to develop an android application.

The document covers the differences between different technologies and applications, it describes why to use some technologies over other ones, by analysing their advantages and disadvantages, this document.

Research Document
Islands And Bridges

Introduction

As a part of my 4th year software development studies I was asked to develop a project, based on my lectures project choices, I have decided to choose the project named Islands and Bridges, I felt like this application could be a good challenge and knowledge for me.

Bridges and island puzzle

Hashiwokakero is a type of logic puzzle published by Nikoli. It has also been published in English under the name Bridges or Chopsticks.

How does Hashiwokakero Work

Rules of the game:

Hashiwokakero is played on a rectangular grid with no standard size, although the grid itself is not usually drawn. Some cells start out with (usually encircled) numbers from 1 to 8 inclusive; these are the "islands". The rest of the cells are empty.

The goal is to connect all of the islands by drawing a series of bridges between the islands. The bridges must follow certain criteria:

● They must begin and end at distinct islands, travelling a straight line in between.

● They must not cross any other bridges or islands.

● They may only run orthogonally (i.e. they may not run diagonally).

● At most two bridges connect a pair of islands.

● The number of bridges connected to each island must match the number on that island.

● The bridges must connect the islands into a single connected group.

Similar Applications

Different types of hashi puzzle game on play store:

Conceptis Hashi
https://play.google.com/store/apps/details?id=com.conceptispuzzles.hashi&hl=en
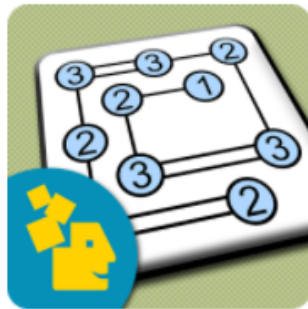
Conceptis Hashi

Conceptis Ltd.   Puzzle   ★★★★⯪ 1,219 ﹢

▣ PEGI 3

Offers in-app purchases
ℹ This app is compatible with all of your devices.

[+] Add to Wishlist   Install

Downloads: 50,000-100,000

Rating: 4.5 stars.

"Hashi are addictive bridge-connecting puzzles which were invented in Japan. Using pure logic and requiring no math to solve, these fascinating puzzles offer endless fun and intellectual entertainment to puzzle fans of all skills and ages."

PUZZLE FEATURES

• 90 free Classic Hashi puzzle samples
• 30 extra-large puzzles bonus for tablet only
• Extra bonus puzzle published free each week
• Multiple difficulty levels from very easy to extremely hard
• Puzzle library continuously updates with new content
• Manually selected, top quality puzzles
• Unique solution for each puzzle
• Hours of intellectual challenge and fun
• Sharpens logic and improves cognitive skills

GAMING FEATURES

• Concurrently playing and saving multiple puzzles
• Puzzle library sorting and hiding options
• Unlimited Undo and Redo
• Highlight allowed bridge directions
• Highlight bridge segments
• Optional bridge error warning during gameplay
• Check puzzle
• Track puzzle solving times

This app has a lot of features like different kind of mods (easy, normal , hard) for e.g if you choose normal level it will have more islands the easy mod and the same goes for hard.

This app also provides extra large level but it is for tablets only.

This app is not capable to run on a PC or laptop.

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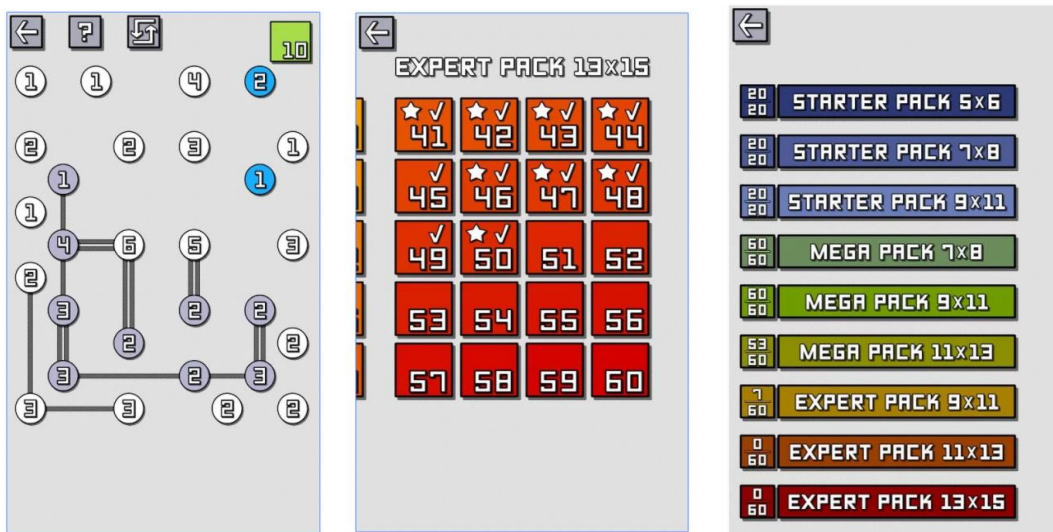Hashi Puzzles: Bridges Islands by Frozax Games.
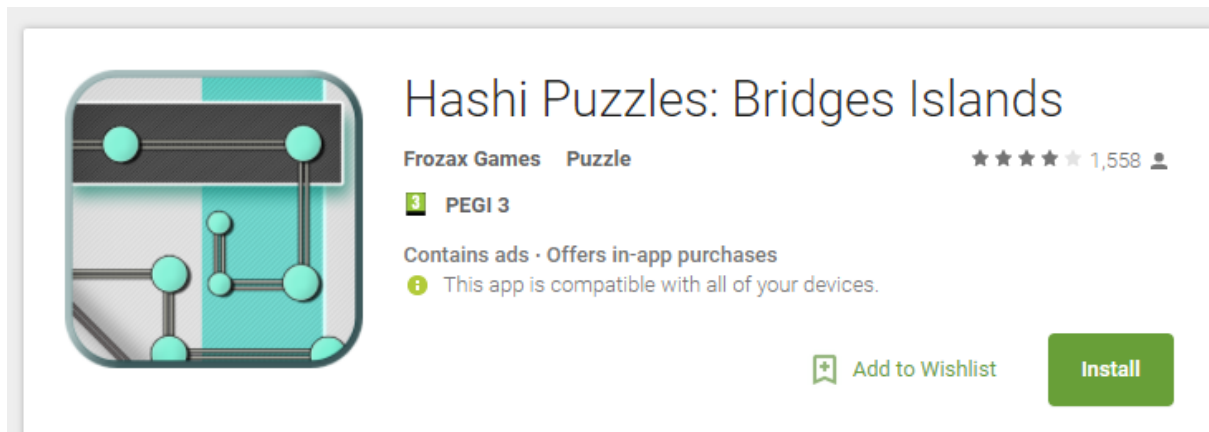
Downloads: 100,000 - 500,000

Rating: 4 Stars.

This application is semi free to play we can install it for free but to get all the levels you must pay.

Shitty Design

Looks Childish

The app has a lot of levels, but they are not made automatically they are pre-coded and this app is not 100% free.

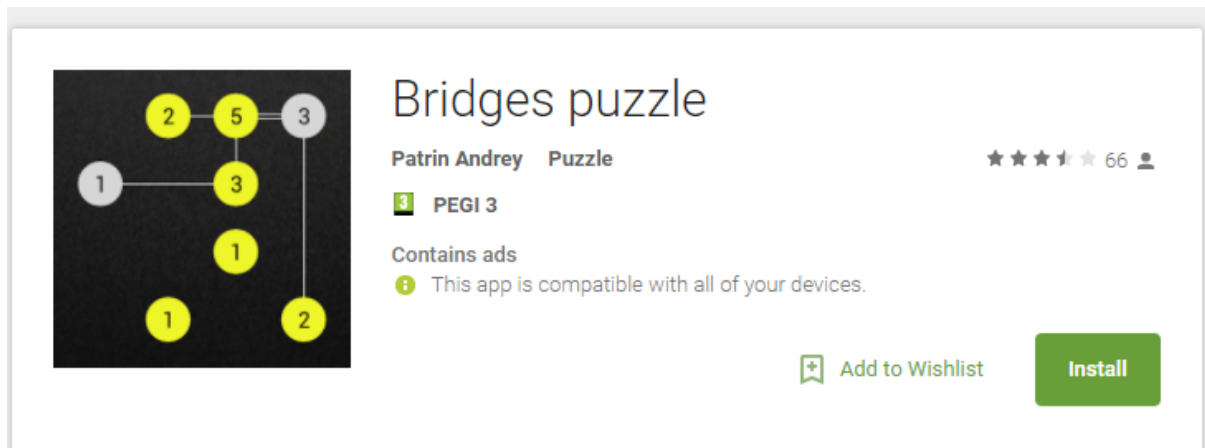Research Document
Islands And Bridges
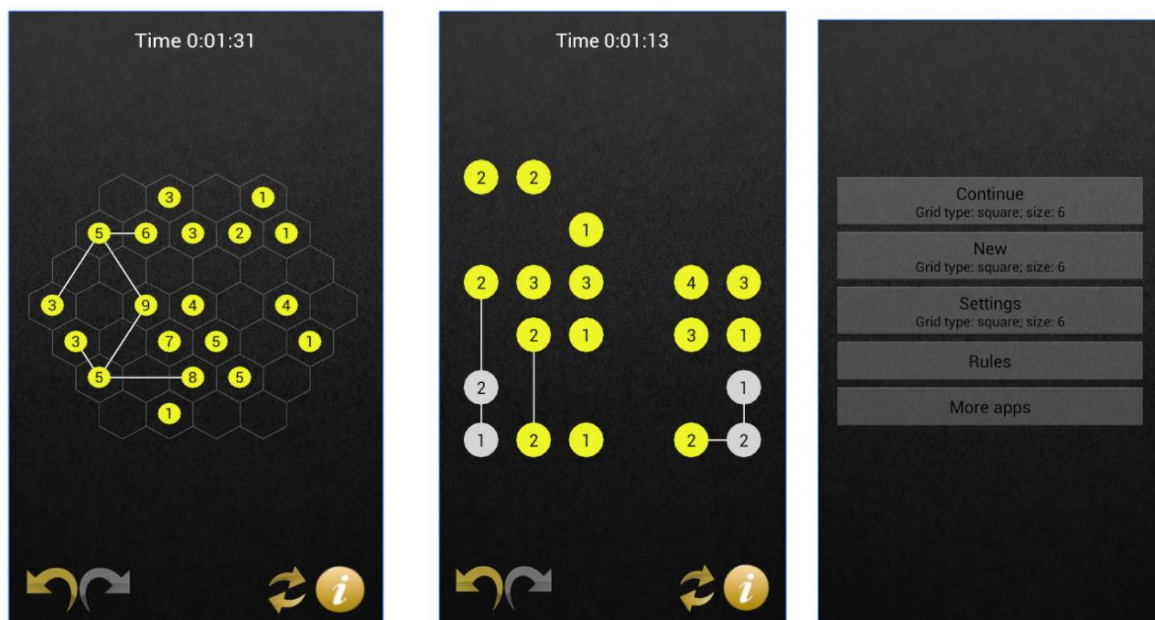
Title: Bridges puzzles

By: Patrin Andrey

Downloads: 5,000 – 10,000

Rating: 3.5 stars

This app is the least popular from the apps I have researched it has lots of available levels/maps from 3x3 to 15x15.

This app also provides different display such as honeycomb, this can provide a little more interest for the user to choose/download this specific app.

Title: Bridges

Issued by Wili

Downloads: 10,000-50,000

Rating: 3.5 stars
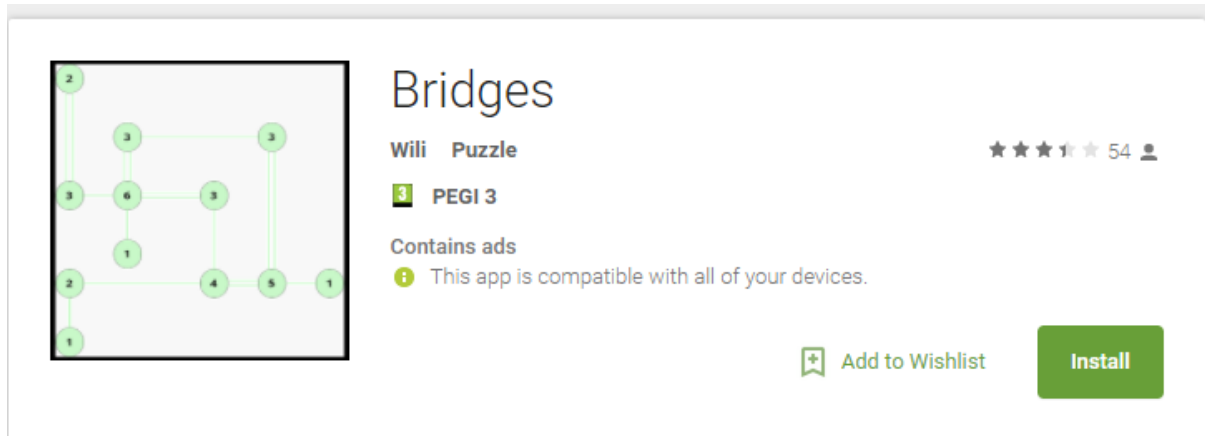
This app is very basic in design and in use, the disadvantage of this app is that the language is French which can be difficult for a non-French speaking user.

I really like the design of this app its easy to use and although its in different language than English it's still easy to navigate through the app.
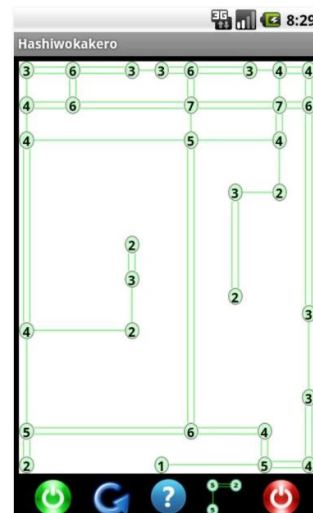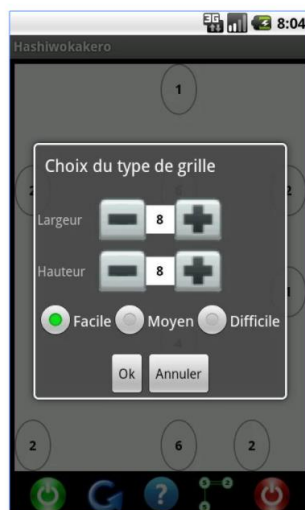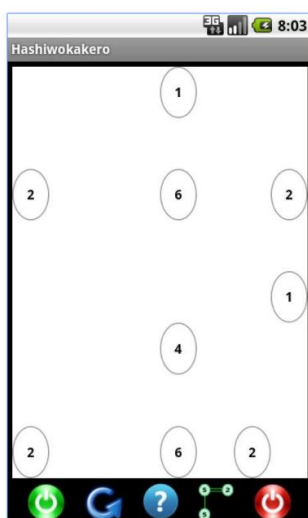
What will make my application stand out?

In my game I will create a leader board that will make my application stand out, this leader board will store all the users scores, making it competitive and more interesting to play. My application will also make the map respawn at random meaning that every level is unique and has only one solution

Android Development

Why choose android development over any other mobile OS?

- More users. In 2017 Android owes 64% of the world's mobile market, which is twice higher than iOS does (32%). It means that you have 2 potential users of your app instead of 1.
- More users mean more downloads. More downloads mean more profit from ads. By the way, Android users are far more loyal to in-app ads than iOS users. So you can easily turn high downloads into a big profit.
- It's easier to publish an app to Google Play rather than to App Store. Google Play has less strict check and lower fee (one-off $25 payment comparing to Apple's $99 annual fee). This advantage may be especially important for beginners.
- Android development is for free and written in java with the SDK tool.

Programming Languages

There are a wide range of programming languages I could use to develop my application.

- Java - primary android development language
- Kotlin, language from JetBrains which received first-party support from Google, announced in Google I/O 2017
- C++ - NDK for libraries, not apps Python, bash, et. al. - Via the Scripting Environment Corona-One is to use the Corona SDK . Corona is a high level SDK built on the LUA programming language. LUA is much simpler to learn than Java and the SDK takes away a lot of the pain in developing Android app.
- Phonegap technology / Cardova - which used HTML 5, JavaScript, CSS
- Xamarin technology - that uses c# and in which mono is used for that. Here MonoTouch and Mono for Android are cross-platform implementations of the Common Language Infrastructure (CLI) and Common Language Specifications.

Java

Java has emerged as the object-oriented programming language of choice. Some of the important concepts of Java include: A Java virtual machine (JVM), which provides the fundamental basis for platform independence.

Personally my first would option would be to develop the Application in java as I have 2 years of experience working with java and java is "pretty much the official language of Android Development" although after researching this I found that "Java as a whole also has some pretty well-documented language issues, including endless try-catch blocks, a lack of extendibility, null-unsafety (and that infamous NullPointerException), not to mention a lack of support for functional programming features. Although Java is starting to add some functional programming elements, such as lambda expressions and functional interfaces, at its core Java is still a procedural language. Java's syntax is also verbose, particularly when compared to many modern programming languages."

Research Document
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Kotlin

Kotlin is a great option for Android Development its fully compatible with JDK 6 (Java Development Kit) this means that kotlin applications can run on older android devices, Kotlin tooling is fully support in Android Sutdio.

Kotlins application run in the same speed as Java one this is because Kotlin has a very similar bytecode structure, Kotlin also support inline functions kotlin often runs faster than the same code written in Java it also supports lambdas.

Why use kotlin over Java for android Development

- Kotlin has Readable and concise code
- Small runtime
- Performance
- Kotlin Libraries

Phonegap/Cardova

Apache Cordova is an open-source mobile development framework. It allows you to use standard web technologies - HTML5, CSS3, and JavaScript for cross-platform development. Applications execute within wrappers targeted to each platform, and rely on standards-compliant API bindings to access each device's capabilities such as sensors, data, network status, etc.

Cardova Architecture
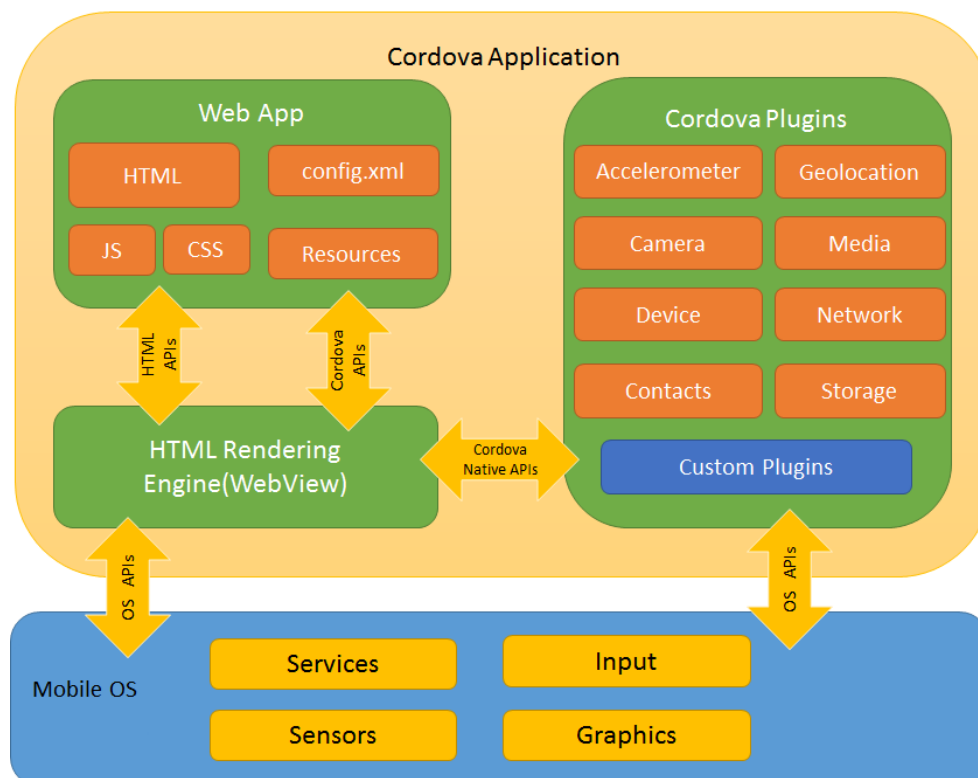
Research Document
Islands And Bridges

Cardova is not a good option for my project as it mainly focuses on web apps, this is not what I want as my application will not be hosted on a web service. The road I will take with my Application is to build a native application, rather than hybrid.

Kotlin Or Java

I will use Kotlin for my Android Development because it provides more compatibility than java and it allows us to use inline functions and lambdas it also support JDK 6 which allows us to basically run on any device even old ones that require JDK 6, by using inline functions in Kotlin we can improve the performance and the speed.

IDE's

Android Studio

Android Studio is the official Integrated Development Environment (IDE) for Android app development, based on IntelliJ IDEA. On top of IntelliJ's powerful code editor and developer tools, Android Studio offers even more features that enhance your productivity when building Android apps, such as:

- A flexible Gradle-based build system
- A fast and feature-rich emulator
- A unified environment where you can develop for all Android devices
- Instant Run to push changes to your running app without building a new APK
- Code templates and GitHub integration to help you build common app features and import sample code
- Extensive testing tools and frameworks
- Lint tools to catch performance, usability, version compatibility, and other problems
- C++ and NDK support
- Built-in support for Google Cloud Platforms, making it easy to integrate Google Cloud Messaging and App Engine

Advantages

- Compatible with Kotlin and its libraries.
- Android studio allows kotlin and java code in the same project without any errors.
- It's a native android IDE

Disadvantage

- Needs at least 4-6gb+ of RAM to run flawlessly

Eclipse

An integrated development environment (IDE) is a software application that provides comprehensive facilities to computer programmers for software development. An IDE normally consists of a source code editor, build automation tools, and a debugger. Most modern IDEs have intelligent code completion. Some IDEs, such as NetBeans and Eclipse, contain a compiler, interpreter, or both; others, such as SharpDevelop and Lazarus, do not.

The boundary between an integrated development environment and other parts of the broader software development environment is not well-defined. Sometimes a version control system, or various tools to simplify the construction of a graphical user interface (GUI), are integrated. Many modern IDEs also have a class browser, an object browser, and a class hierarchy diagram, for use in object-oriented software development.

Advantages

- It Does not require the same amount of memory that android studio requires.

Disadvantage

- Not a native Android IDE
- Eclipse no longer supports android development since 2016 although the tools still live in the open source.

Visual Studio

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps.

Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code. Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring.

The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a code profiler, forms designer for building GUI applications, web designer, class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level—including adding support for source control systems (like Subversion and Git) and adding new toolsets like editors and visual designers for domain-specific languages or toolsets for other aspects of the software development lifecycle (like the Team Foundation Server client: Team Explorer). Visual Studio supports 36 different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, Visual Basic .NET, C#, F#, JavaScript, TypeScript, XML, XSLT, HTML, and CSS. Support for other languages such as Python, Ruby, Node.js, and M among others is available via plug-ins. Java (and J#) were supported in the past.

Advantages

- Plug in components that make adding SDKs for commonly used services like Dropbox, Azure, AWS, Auth0 etc. a breeze.
- Cross platform support for phone functionality like camera, geolocation etc. with Xamarin.Mobile.
- No context switching between languages. We can go from iPhone to android to the web using one language.
- A choice of IDEs including their own Xamarin Studio, or Visual Studio if you want to use it.
- Excellent Support.

Disadvantages

- Not a Native android app.
- Requires Xamarin.
- Xamarin does not come cheap.

Conclusion IDE's

I have picked android studio as my IDE for Android Development it is a native android IDE that allows more than any other IDE out there although it uses up a lot of memory. Eclipse would my 2nd choice because it had a lot of similarities to android studio and used up less memory, but android development has been deprecated since 2016 for eclipse.

Framework

Phone Gap

- "Performance: Phonegap app's performance is not at par with a native android application.
- Functionality: As one would expect you can't have all the functionality support a native android application has.
- Look: You could easily tell apart a phonegap application from a native one. Given phonegap renders all the content in a WebView, the look of native ui elements is lost."

PhoneGap is a good option for my Framework it focuses mostly on HTML5, CSS, JavaScript for my app development. This is ideally for my project because my front end will be written in HTML5 and CSS.

Activity Lifecycle

The user navigates through, out of and back to the app the activity instance provides many call backs that allow the activity to if the state has changed e.g. system is creating, stopping or resuming an activity.

- A user got a phone call while he was using the app, it prevents the app from crashing and it doesn't allow to run a different app while my app is open.
- It also prevents from slowing down the phone when the user is not actively using it.
- Activity Lifecycle prevents the user's progress if they leave my app and return to it later on.
- Activity prevents from crashing the app when a user rotates between landscape and portrait.
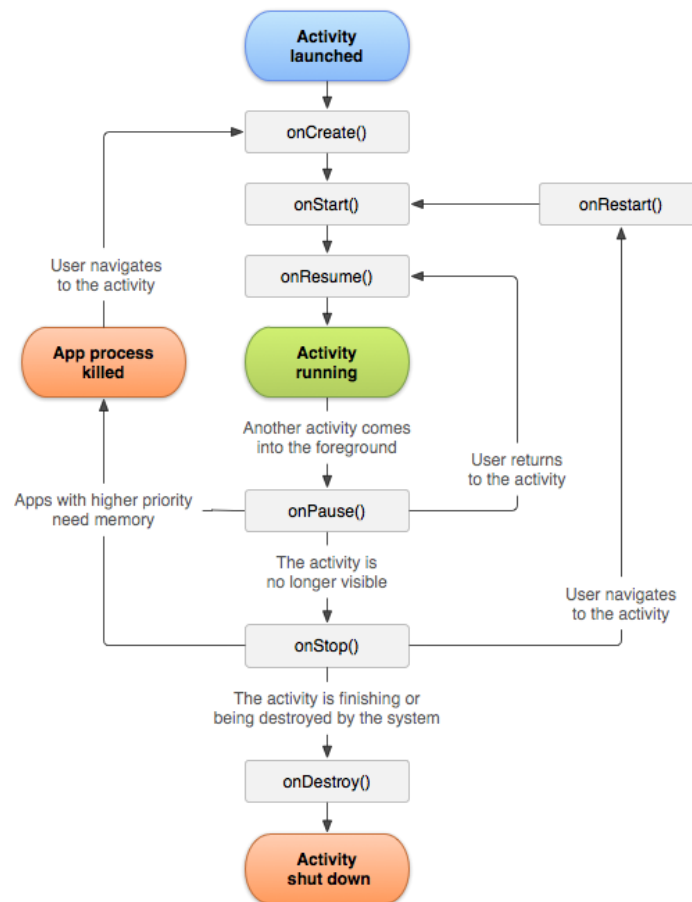
Threading

When an application is started, Android creates a thread known as "main" or UI thread. Main Thread is responsible to send events to the UI (user interface).

To keep my application responsive, I need to avoid blocking the main thread by performing a operation that may black the thread.

Blocking the "main" Thread can result in a app freeze which then it can lead the user to quit or uninstall the app if the user is unhappy.

"In Android, you can categorize all threading components into two basic categories:

1. Threads that are attached to an activity/fragment: These threads are tied to the lifecycle of the activity/fragment and are terminated as soon as the activity/fragment is destroyed.

2. Threads that are not attached to any activity/fragment: These threads can continue to run beyond the lifetime of the activity/fragment (if any) from which they were spawned."
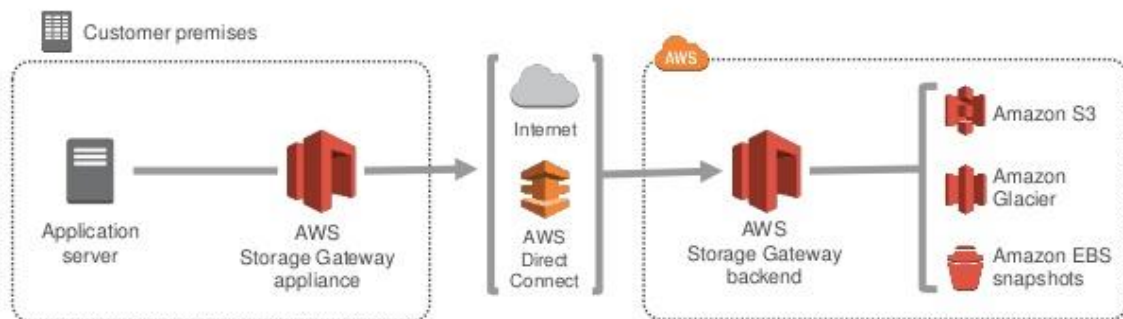
Cloud

What is Cloud Storage.

Cloud storage is a model of data storage in which the digital data is stored in logical pools, the physical storage spans multiple servers (and often locations), and the physical environment is typically owned and managed by a hosting company.

These cloud storage providers are responsible for keeping the data available and accessible, and the physical environment protected and running.

People and organizations buy or lease storage capacity from the providers to store user, organization, or application data. Cloud storage services may be accessed through a co-located cloud computer service, a web service application programming interface (API) or by applications that utilize the API, such as cloud desktop storage, a cloud storage gateway or Web-based content management systems.

How does cloud storage work?

Cloud storage vendors build and operate infrastructure that manages capacity, security and durability to make data accessible to applications all around the world. Applications access cloud storage through traditional storage protocols or directly via an API. Many vendors offer complementary services designed to help collect, manage, and analyse data at massive scale.

Benefits of cloud storage
Storing data in the cloud lets IT departments transform three areas:

1. Total Cost of Ownership. With cloud storage, there is no hardware to purchase, storage to provision, or capital being used for "someday" scenarios. You can add or remove capacity on demand, quickly change performance and retention characteristics, and only pay for storage that you use. Less frequently accessed data can even be automatically moved to lower cost tiers in accordance with auditable rules, driving economies of scale.

2. Time to Deployment. When development teams are ready to execute, infrastructure should never slow them down. Cloud storage allows IT to quickly deliver the exact amount of storage needed, right when it's needed. This allows IT to focus on solving complex application problems instead of having to manage storage systems.

AWS vs Azure cloud storage.

What we know is that AWS and Azure are the leaders as together they hold 50% of the market.
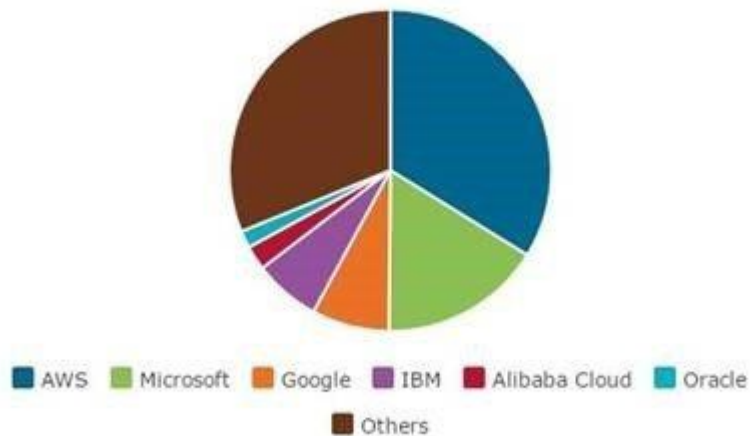
First, let's take a quick look at how the two companies explain their offerings.

Microsoft Azure
Azure is a comprehensive set of cloud services that developers and IT professionals use to build, deploy, and manage applications through our global network of datacenters*. Integrated tools, DevOps, and a marketplace support you in efficiently building anything from simple mobile apps to internet-scale solutions.*

AWS
Amazon Web Services (AWS) is a secure cloud services platform, offering computepower, database storage, content delivery and other functionality to help businesses scale and grow. Explore how millions of customers are currently leveraging AWS cloud products and solutions to build sophisticated applications with increased flexibility, scalability and reliability.

AWS also is offering free trial for 12 months and has great documentation for people without previous experience in cloud development.

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Algorithm
Depth first search

The DFS algorithm is a recursive algorithm that uses the idea of backtracking. It involves exhaustive searches of all the nodes by going ahead, if possible, else by backtracking.

Here, the word backtrack means that when you are moving forward and there are no more nodes along the current path, you move backwards on the same path to find nodes to traverse. All the nodes will be visited on the current path till all the unvisited nodes have been traversed after which the next path will be selected.

This recursive nature of DFS can be implemented using stacks. The basic idea is as follows:
Pick a starting node and push all its adjacent nodes into a stack.
Pop a node from stack to select the next node to visit and push all its adjacent nodes into a stack. Repeat this process until the stack is empty. However, ensure that the nodes that are visited are marked. This will prevent you from visiting the same node more than once. If you do not mark the nodes that are visited and you visit the same node more than once, you may end up in an infinite loop.

I am going to recursively search through the nodes to ensure that the puzzles the generator makes are within the rules of the puzzle the generator followed these steps:

1. Put a single random node somewhere on the board.

2. From a random node already on the board, draw a single or double bridge (decided randomly) in a random direction. This will not happen if the node has no more options to draw a bridge and a new node from where to draw a bridge will randomly be chosen.

3. During this traversal, on every grid point decide whether to go on drawing the bridge or to stop and put an island on that spot. If you encounter a crossing bridge at the grid point, place the node on the bridge, if possible, or otherwise place the node one step back, if possible. 12

4. Continue steps 2 through 4 until you have reached the number of nodes you'd like to have (given in the command line when starting the generator).

5. Check at each node how many bridges are connected and give the node the proper value.

6. Remove the bridges from the puzzle and it is complete.

Summary and Conclusion

Form my research I have decided that I will implement the application I android studio using Java with Kotlin, I think this will be the best option for my project as I have learned java for the first 2 years of my college and I also enjoy programming in java, for my IDE I will choose Android Studio because is the native IDE from android and it supports everything that I need. I also have android

smartphone, this will help me to check if the app is working on a real phone rather than the emulator.

I will choose AWS as my backend for the application because It provides 12 months free trial and has great documentation for programmer that have no experience in Cloud development.

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