Planning a programming project[1]

Becoming a programmer isn't just about learning the syntax and the concepts of a programming language: it's about figuring out how to use that knowledge to make programs. You've made a bunch of programs in your courses but now you should come up with ideas for new programs - **ideas that you're personally really excited about** - and try to turn those into actual programs.

You probably won't know everything you need for your program when you start it, and that's totally okay -- you'll be motivated to learn those new things because of how much you want to make your program real. Programmers are constantly learning new things for new projects, and that's part of why we love it so much.

Getting Started

1. Follow this link to add yourself to the CSC420 classroom and create your github repository:

   https://classroom.github.com/a/j_It6hCD

2. Once you have your repo created, get a copy of it onto your computer using git clone. It is probably a good idea to create a directory/folder for CSC420, for containing all repos related to this course.
3. Make a copy of this document
4. Select your copy of this document to edit
   a. You will edit the document using Google Documents
   b. Submission instructions at the bottom will tell you how to submit your document.
5. **ALL SOURCES THAT YOU PLAN TO CONSIDER AS PART OF YOUR PROJECT MUST BE CITED.**
6. **IT IS NOT OKAY TO SIMPLY FOLLOW A YOUTUBE OR OTHER TUTORIAL TO COMPLETE YOUR PROJECT.**
7. **THIS HAS TO BE YOUR OWN WORK.**
8. **IF IN DOUBT ABOUT SOMETHING, ASK FOR CLARIFICATION – FIRST.**

Let's step through the process of planning a programming project.

[1] *Planning a programming project (article) | Khan Academy*. (n.d.). Retrieved January 16, 2023, from https://www.khanacademy.org/computing/computer-programming/programming/good-practices/a/planning-a-programming-project

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1. What do you want to make?

When I first started programming, I found myself constantly thinking of new programs to make and writing those down in a list. I was addicted to the power of creation, and there was so much my brain wanted to make. If you're like that, then you probably already have an idea of what you want to make, and perhaps you have your own list.

If you don't already have an idea, then here are some questions to help your brainstorming:

- What's your favorite game - arcade game, board game, sports game? Could you make a simplified, digital version of that? Could you mix it up a bit, like give it a different theme or main characters?
- What are your other favorite academic fields? If you love art, could you make an art-making program? If you love history, how about an interactive timeline? If you love science, how about a scientific simulation?
- What's your favorite movie or TV show? Could you make a digital version of a scene or character from it? Maybe make a game based on it?
- What's a real-life gadget that you love? Could you make a simulation of it?

Once you've picked an idea, you should write a description of it. For example, if I decided to make a clone of "Breakout", because that's my favorite retro arcade game, I might write:

Breakout: a game where you control a paddle at the bottom of the screen, and you use it to hit a ball upwards and at angles to break bricks. The goal is to break all the bricks, and not let the ball through the ground too many times.

You'll flesh that description out later, but for now, that gives you a good enough idea to keep going in the planning process.

1. **Your favorite idea from the previous assignment. Repeat the idea here. Add additional detail if you have it.**	I want to create a mobile application that is going to monitor and track the condition of infrastructure and public facilities, such as schools and hospitals and others. The way it would work: user directs the camera from the application on

	a building, and the program recognizes it as an object and classifies it under "Well-maintained", "Moderately maintained" and "Poorly maintained" categories. I am interested in this idea because I am participating in the Google Developers Student Club's Solution Challenge and my solution would solve the UN Sustainable Development Goal 9 (Industry, Innovation and Infrastructure).

2. What technology will you use?

In this step, you need to consider which technologies (languages/libraries/environments) you're familiar with or able to learn easily, and which of them are the most well suited for the job.

You *can* learn a new technology for a new project, but especially if you're just getting started in programming, it's a good idea to get really good at your first language first.

2. Itemize the technologies you plan to use, such as languages, IDE, libraries, operating systems, etc. List all the ones you can think of.	1. First, I need to gather and label a large dataset of images of various public facilities, such as schools and hospitals, in various conditions (e.g. well-maintained, in need of repair, etc.) in Berea. This dataset will be used to train the image recognition model. In order to obtain my dataset, I will either manually pick a couple of buildings and get pictures of them or I am going to use Google Maps images. 2. Second, I would need to use Google's Cloud Vision API to train a machine learning model to recognize and classify images of public facilities based on their condition. The Cloud Vision API offers pre-trained models as well as the ability to train custom models using your own dataset. 3. Develop the user interface for the app, which will allow users to take or upload a picture of a public facility and receive information about its condition. For this, I will need to use Flutter programming language and necessary dependencies and libraries such

	as camera plugin etc. 4. Integrate the image recognition model into the app and test it on a variety of images of public facilities to ensure that it is working correctly. For that, I would install Flutter SDK and VS code.

Carefully read sections three (3) and four (4). Question three (3) of this assignment follows sections 3 and 4.

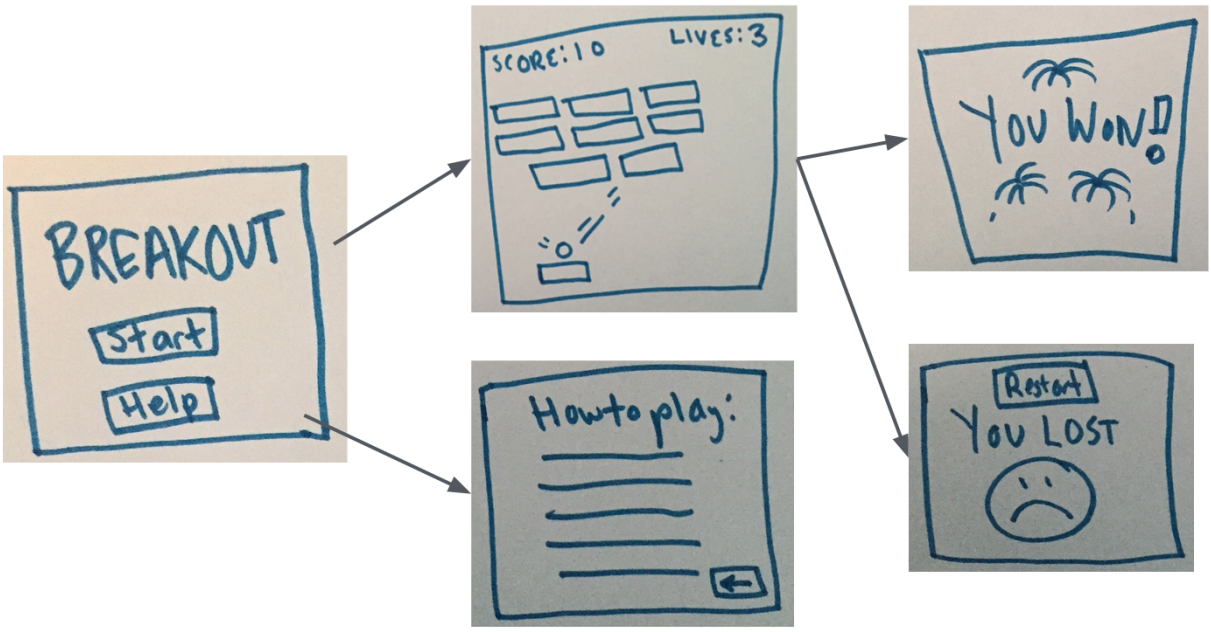
3. What features will it include?

This is where we get into the real planning, and where (I think) it gets fun. Your goal in this step is to figure out what you're actually making- what will it look like, what features it will include, what features it *won't* include.

The first thing you can do is make "mock-ups" – sketches that look like the thing you're making, but without details like coloring or exact sizing.

You can make mock-ups on paper, or with online programs:

To give you an idea of what mock-ups look like, I've included mock-ups below of my Breakout clone. I sketched each scene separately and drew arrows between them to show how one scene leads to another. Those arrows will help me understand what logic I need in my program to go between program states.



Sketched mock-ups of a Breakout clone

Now you can use those mock-ups to help you make a feature list, where you think of every feature in your program, and make it into a list.

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For my Breakout clone, this could be my feature list, broken down by scene:

Game scene

- User-controlled paddle
- Multiple colored bricks
- Angled ball movement
- Collision detection
- Life display
- Score display
- Sound effects

Main Scene

- Play button
- Help button

Help Scene

- Text
- Back button

Win Scene

- Headline
- Fireworks animation

Lose Scene

- Text
- Restart button

Include mock-ups here

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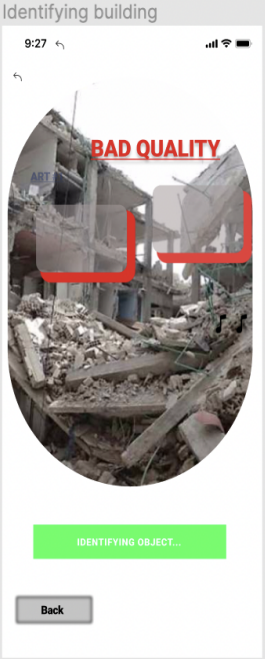
CSC 420 - Programming Languages
P0127: Planning a Programming Project

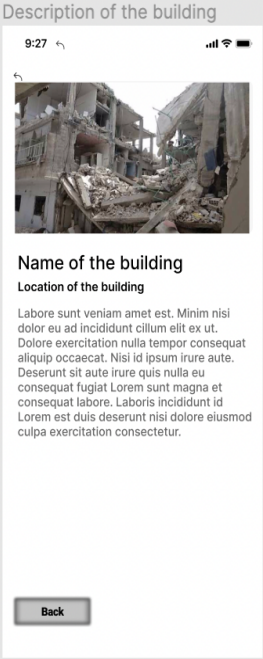
Main page

Scan the building page

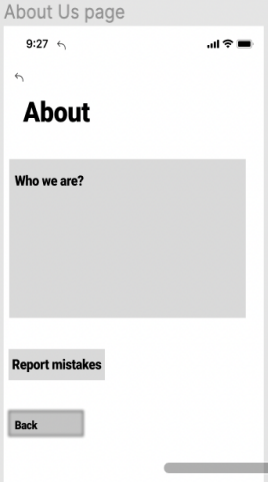
Identifying building



Description of the building



About Us page



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4. But what features must it include?

If we all had infinite time to make all the programs in our heads, then they'd all include every feature in our list. But we don't, so in this step, you have to decide which features are the most important, and which features you'll do only if we have time. This will also help you figure out which order to implement features in, from most to least important. To help you figure out the importance of each feature, ask yourself these questions:

- If I shared this with a friend, which features would I want to make sure were working?
- Which features am I the most excited about building?
- Which features are the most unique to my program?
- Which features will I learn the most from implementing?
- Are there any features that seem too far beyond my current skill level?

Then, go through your feature list from the last step, and either order the list or add a rank to each feature.

For my Breakout clone feature list, I've put "P1", "P2", and "P3" next to the features, signifying top priority (P1), middle priority (P2), and lowest priority (P3). I decided to prioritize the unique game mechanics over general game features like scenes, because I find that the most exciting about this project:

> You can also think of Priorities in these terms:
> **P1 - Must have**
> **P2 - Good to have once P1 priorities are completed**
> **P3 - Nice to have if there is time after P1 and P2 priorities are completed**

(P1) Game scene
- (P1) User-controlled paddle
- (P1) Multiple colored bricks
- (P1) Angled ball movement
- (P1) Collision detection
- (P2) Life display
- (P2) Score display
- (P3) Sound effects

(P2) Main Scene
- (P2) Play button
- (P3) Help button

(P3) Help Scene
- (P3) Text
- (P3) Back button

(P2) Win Scene
- (P2) Headline
- (P3) Fireworks animation

(P2) Lose Scene

- (P2) Text
- (P3) Restart button

As a general tip for those of you making games, here are features that I'd recommend de-prioritizing: menus, multiple levels, 3D graphics. Focus on what's unique and fun about your game, then add those extras.

You can also turn your prioritized list into project versions, so you can easily see what you need to implement in each version and you can always stop after a particular version and be happy with what you've made.

Here's what the versions would look like for my Breakout clone:

V1

- User-controlled paddle
- Multiple colored bricks
- Angled ball movement
- Collision detection

V2

- Life display
- Score display
- Start scene w/play button
- Win scene w/headline

V3

- Sound effects
- Help button
- Fireworks
- Lose scene w/Restart button

3. Section	Feature	Priority	Version	Notes
Game Scene	User-controllable Paddle	1	1	Example
Camera Scene	A feature that allows users to take photos of buildings using the device's camera.	1	1	The user should be able to click the “Scan building” button and it should prompt him to a camera window.
Camera Scene	Image Recognition	1	1	A feature that uses image recognition technology to analyze the photos and determine the maintenance quality of the building.
Results Scene	Results Display	1	1	A feature that displays the results of the maintenance evaluation, including a rating or a detailed report, to the user.
Home Screen Scene	Upload pictures	1	1	A feature that would allow the user to upload pictures of the building from local gallery .
About Us Scene	Info displayed	1	1	Create a page “About Us” that would display information about the app’s features.
Maps Scene	Have embedded Google Maps in the App	2	1	Have functional Google Maps embedded in the app
About Us Scene	Have a button to navigate users to enter their feedback/any errors noticed in the app	2	1	Have a button to navigate users to enter their feedback/any errors noticed in the app
Navigation Scene	Navigation feature	2	1	A feature that allows users to review previous evaluations, access other parts of the app,

				and navigate to different screens.
Data Storage Scene	Data Storage feature	3	1	A feature that stores the photos and evaluation results securely and allows users to access and view their data at any time.
Login Scene	User Accounts feature	3	1	A feature that allows users to create and manage their own accounts, including the ability to save and access their evaluations over time.

Add as many rows to the table above as you need.

5. How will you implement it?

You now have an idea of what features you'll be building first in your program - but if you start now, you'll be staring at a completely blank program with no code written, and that can be intimidating. Which variables should you write first? Which functions?

One way you can figure that out is to think about the "high level architecture" of your program - breaking it into categories like "objects", "logic", "user interaction", "user data", and "scenes" - and then think about how you might implement them, like as object-oriented object types, functions, or variables.

For example, here's an architecture for my Breakout clone:

Objects

- `Brick` (`.isHit()`)
- `Paddle` (`.move()`)
- `Ball` (`.move()`)

Scenes

- Start
- Game
- End

Logic

- Ball-brick collision (`function`, use bounding box)
- Paddle-ball angling (`function`, invert angle)

User interaction

- Keyboard-paddle movement (`keyPressed`)
- Buttons for scene changes (`mouseClicked`)

User data

- Ball deaths (`array`)
- Ball hits (`array`)

Once you've thought about the high-level architecture, it should become more-clear what you can start coding first.

You might decide to write your whole program in pseudo-code first, which we talk about later in this tutorial. Basically, it'd mean writing the whole program in plain English text inside a comment, and then slowly turning that into actual code.

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4. Classes, Methods, User Interface/Scenes, User Data, Logic	**Description**
Classes:	
BuildingPhoto	A class that represents a single photo of a building and includes variables such as the image path, building name, location, date, and maintenance score.
UserAccount	A class that represents a user account and includes variables such as the username, email, and a list of photos taken by the user.
Location	A class that represents the location of a building or facility, including latitude, longitude, and address information.
MaintenanceRecord	A class that represents a record of maintenance performed on a building or facility, including date, type of maintenance, and cost.
BuildingEvaluation	A class that evaluates the overall condition of a building based on multiple photos and assigns a score.
Methods():	
evaluateMaintenance()	A method within the BuildingPhoto class that calculates the maintenance score of a building based on image analysis and recognition techniques.
addBuilding()	A method within the User class that allows a user to add a new building to the app's database.
updateMaintenanceScore()	A method within the Building class that updates the building's overall maintenance score based on the scores of all its associated photos.
calculateConditionScore	A method that takes a photo of a building or facility and calculates a score based on image recognition technology and machine learning

	algorithms.
retrieveFacilityPhotos	A method that retrieves all photos of a particular facility and returns them as a list of FacilityPhoto objects.
getBuildingCondition	A method that retrieves the overall condition of a building based on multiple photos and returns it as a BuildingCondition object.
Logic:	
Image Analysis	Algorithms and techniques used to analyze the image and determine the maintenance score of a building.
Photo Management	Logic that allows a user to add, delete, and manage their photos within the app.
User Data:	
Building List	A list of all buildings in the app's database, stored as Building objects. User List
Building Information	Data such as the name, address, and size of a building or facility.
Maintenance Records	Data such as the type and cost of maintenance performed on a building or facility over time.
Building Images	Photos of buildings and facilities taken by users, including the date and time they were taken.

Add additional rows to this table if you need them.

6. What's your timeline?

How much time do you have to make this program? How many weeks, and how much time each day? What features will you write each week? Your goal in this step is to figure out a timeline for your project - which is particularly important if you have a deadline, but also useful so you start to understand how much time it takes you to write a program.
Here's a timeline for my Breakout clone, assuming 2-4 hours of work each week:

- Week 1: Design and pseudo-code
- Week 2: Rough visuals
- Week 3: Ball moving/collision mechanics
- Week 4: Scoring mechanics
- Week 5: Scenes (Start/Win/Lose)
- Week 6: Polish, Manual tests (QA), Prep for demo

Figuring out timelines for programming projects is hard. Some things that seem easy take way longer than you expect (like some weird bug that you spend hours debugging), some things that seem hard take less time than you expect. As a general rule, assume it will take you longer than you think, and adjust as you go along.

5. Week	**Weekly Plan**
1 (01/29-02/04)	Familiarize yourself with the Google Image Recognition API Create basic user interface using Flutter Define the data structures and objects that will be used in the app
2 (02/05-02/11)	Implement the logic for image recognition Test the image recognition logic with sample data Define the user data structures and implement basic data storage functionality
3 (02/12-02/18)	Implement the logic for weather correction and maintenance schedule Test the weather correction and maintenance schedule logic with sample data Implement basic functionality for user authentication and data access control
4 (02/19-02/25)	Implement the cost estimation and facility comparison logic

	Test the cost estimation and facility comparison logic with sample data Integrate all logic into the user interface
5 (02/26-03/04)	Perform final testing and debugging of the app Document the code and create a user manual Prepare a final project presentation
6 (03/05-03/11)	*SPRING BREAK* – WORK CAN BE DONE THIS WEEK Refine and polish the user interface Incorporate feedback from beta testing Finalize the project and submit it by the due date
7 (03/12-03/13)	Project Due 2023-03-13 at 11:59 PM

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Are you ready!?

Hopefully this gives you an idea for the process of planning a programming project and inspires you to start a project now.

The important thing is to make sure you start making your own programs at some point, because that is where you'll learn the most, and also where you'll get the most joy out of programming, because you're making your dreams into reality.

Submission

1. Download this document as a PDF and put it in your git repository by adding it to your repo's directory on your computer
2. git add, commit, and then push this to git by the deadline set in Moodle

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