Dots & Co

Assignment 3
CSSE1001/7030
Semester 2, 2017

Version 1.1.2
25 marks / 30 marks

Due Friday 27 October, 2017, 21:30

1. Introduction

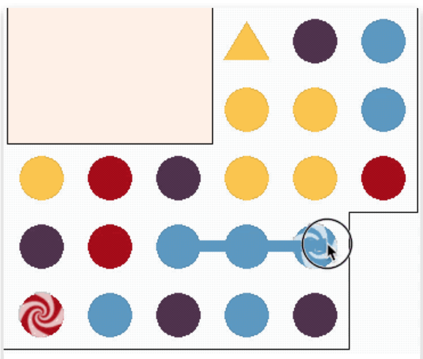
This assignment provides you the opportunity to apply concepts taught throughout the course to extend the functionality of a basic dot game, which has been modelled on Dots & Co.

The assignment will focus on the concept of Graphical User Interfaces (GUIs). You will be required to extend the base game with basic, intermediate, and advanced features. Postgraduate students will have an additional task.

Students are encouraged to review Dots & Co, as well as other similar games, to better understand how the game is played and for inspiration on advanced features.

Because this assignment deals with multiple files, students are encouraged to investigate a more capable IDE. The author recommends PyCharm, which is free for students.

1.1. Game Play


Game Play Example

Dots & Co is a simple game where the player tries to create connections between dots on a grid in order to reach objectives.

The player can click on a dot and drag to an adjacent dot (up/down/left/right only) to select a dot to form a connection, continuing on to another adjacent dot to select it to form another connection, et cetera. When the player stops dragging and releases, all dots in that have been selected will be activated and removed. The most basic dots do not have any effect when activated. Replacements drop down from the cells above, and new dots are generated off-screen.

If the player drags back to their second-most-recently selected dot, the most-recently selected dot is deselected.

When the user finishes their selection, if the selection contains a loop, all dots of the selected kind will also be included in the activation.

Shortly after this assignment's release, a link to a video overview will be added here.

2. Assignment Tasks

2.1. Task Breakdown

CSSE1001 students will be marked out of 25 and CSSE7030 students will be marked out of 30 based on the following breakdown. Tasks may be attempted in any order, but it is recommended to follow this breakdown, top-down.

	Sub–Task	Marks
Task 1 *Basic Features*		**10 marks**
	App Class	5 marks
	InfoPanel Class	2 marks
	File Menu/Popup Dialogs	1 mark
	IntervalBar Class	2 marks
Task 2 *Intermediate Features*		**7 marks**
	CompanionDot	2 marks
	Dots	2 marks
	Companion	3 mark
Task 3 *Advanced Features*	*Sophisticated, additional functionality*	**8 marks**
Postgraduate *CSSE7030 only*		**5 marks for CSSE7030; 0 marks for CSSE1001**
	ActionBar	3 marks

	Sub–Task	Marks
	More Dots & Companions	2 marks

2.2. Mark Breakdown

For each task, marks will scaled according to the following breakdown.

	Description	Marks
Code Quality	Code is readable. Appropriate and meaningful identifier names have been used. Simple and clear code structure. Repeated code has been avoided.	**10%**
	Code has been simplified where appropriate and is not overly convoluted.	**10%**
	Documented clearly and concisely, without excessive or extraneous comments.	**10%**
Functionality	Components are functional, without major bugs or unhandled exceptions.	**70%**

2.3. Getting Started

Before beginning work on the assignment you must download `a3_files.zip` provided from the course website.

Inside `a3_files.zip`, there should be a file called `a3.py`. This is the file where you will write your assignment. The other files are support files. These **must not** be edited. Their purpose is explained below.

Some tasks require you to submit brief descriptions of features implemented (5. Task 2 – Intermediate Features, 6. Task 3 – Advanced Features, 7. Post–Graduate — CSSE7030 Only). These descriptions **must** be submitted in a single PDF document called `description.pdf` — other formats such as Microsoft Word or misnamed files may not be accepted.

3. Support Code

The file `a3.py` is the main assignment file. This file includes a few hundred lines of code that leverages the support code to help you get started. You must modify & add to this file in order to complete the assignment tasks.

You are also permitted to create other files to simplify the separation of tasks (i.e. `task1.py`, `task2.py`, etc.). If you do this, `a3.py` must be the entry point to your application. One way to achieve this is to move `DotsApp` to a separate file, such as `base.py`. ***Regardless of how you structure your files, the code must all be able to be demonstrated by running*** `a3.py`.

You have been supplied with a copious amount of support code to help you complete this assignment. To begin the assignment, you do not need to understand much of this code. As you progress through the tasks, the degree to which you should understand this code will increase.

File	Description	Understanding
images/companions/	Images of companions	Task 2
images/dots/	Images of dots	Task 2
modules/	Third–party libraries	Task 3
cell.py	Cell classes	Task 3 (`AbstractDot` class)
companion.py	Companion classes	Task 2 (`AbstractCompanion` class)
dot.py	Dot classes	Task 2 (`AbstractDot` class)
game.py	Modelling classes for the game	Task 2 (`DotGrid, DotGame` classes)
factory.py	Classes to manage creation of dots, cells, etc.	Task 3
util.py	Collection of helpful utility functions	Task 2 (`ImageManager` class)
view.py		Task 1 (`ObjectivesView` class)

> **Note:** Only required understanding has been listed. Since task 3 is open-ended, it would be helpful to have a good understanding of most of the support code to know what can be

> leveraged to your advantage.

3.1. Event Listeners

> **Note:** In this section, the word function is used to mean anything that is able to be called like a function, such as a method, a lambda, etc. The generic technical term for this is `callable`.

The `DotGame` & `GridView` classes follow a pattern which allows a function to be attached to an event. When the event is triggered/emitted, the function is called. This function is called a listener or a callback, and this attaching action can also be referred to as binding to or listening for an event. Code that triggers an event can also supply arguments to the event functions.

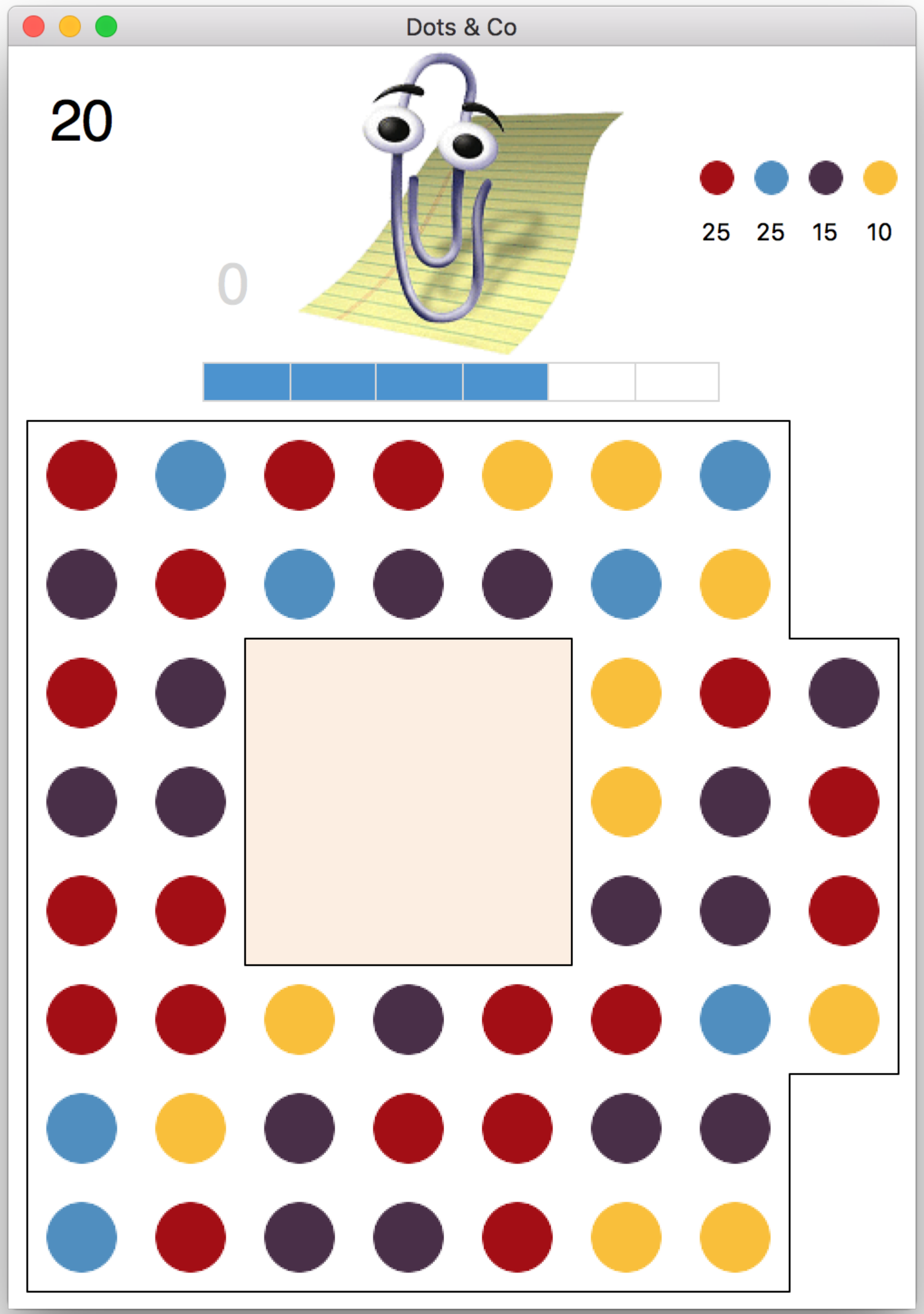
This pattern is called the Event Emitter pattern, and is an implementation of the Observer pattern (the Publisher/Subscriber pattern is similar). It is also an example of a higher–order function (the function does the binding accepts the listener function as an argument).

While it is also quite a similar approach to how Tkinter handles commands for button presses, the Event Emitter pattern is far more flexible in general, primarily because multiple listeners can be attached to the same event.

The events emitted by the `DotGame` & `GridView` classes are very useful, particularly for creating non-blocking animation. The supplied code binds to every relevant event emitted by these classes. See `DotsApp.bind_events` in the `a3.py` file.

4. Task 1 – Basic GUI

The purpose of this task is to create the basic graphical user interface (GUI) for the Dots game. There are several sub–tasks that need to be completed for this task. You will be working towards creating the user interface demonstrated below.



Basic GUI Example

4.1. Basic GUI

You have been supplied with an incomplete implementation of `DotsApp` to start with. You should modify this class to implement the required functionality.

The very first part of this task is to get the app onto the screen. Add your GUI instantiation code to the `main` function in `a3.py`

Next, review the `DotsApp` class and modify the code as required to implement the basic GUI.

The title of the window should be set to something appropriate (i.e. `Dots`). This also applies to any window in subsequent tasks.

As the basic GUI is improved in subsequent tasks, **the `DotsApp` class will need to be modified accordingly**. It is also permitted, to create separate classes for each task using inheritance — this is not required.

4.2. InfoPanel

Define a class named `InfoPanel`, which inherits from `tk.Frame`. This class is used to display information to the user, such as their score, remaining moves and objectives, etc. The `InfoPanel`'s widgets must:

1. be updated whenever necessary (i.e. after the user makes a move that joins some dots , etc. – see `DotsApp._refresh_status`),
2. be laid out *approximately* according[1] to Basic GUI Example, and
3. contain the following widgets:
   - **Remaining Moves *(top–left)*** A label to display the number of moves remaining
   - **Score *(top–left; below & to the right of Remaining Moves)***: A label to display the user's score, in a larger fontsize
   - **Objectives *(top–right)***: An instance of `ObjectivesView` from `view.py` to display the objectives and how many of each remain
   - **Companion *(centre)***: An image of a character of your choosing

> [1] Matching the layout of the example precisely can be achieved far more easily using Tkinter's Grid Geometry Manager (instead of pack). Students are permitted to use this if they wish, but for simplicity, an approximation using pack is equally acceptable.

Note: For convenience, you should have a setter method for each of the relevant widgets. I.e. `set_score(score)`, etc.

The `InfoPanel` will be expanded in 4.4. IntervalBar & 5. Task 2 – Intermediate Features.

4.3. File Menu & Dialogs

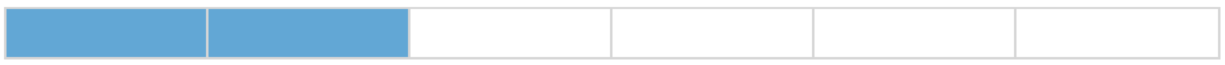
Implement a menu bar, with a `File` menu. The File menu should have the following entries:

- `New Game`: Restarts the game
- `Exit`: Exits the application

When the user attempts to exit the application, either by the file menu or otherwise, they should first be prompted with a dialog to confirm that they indeed want to quit the application. Further, when the game is over, the user should be shown a dialog informing them of the outcome (either win or loss).

Note: On Mac OS X, the file menu should appear in the global menu bar (top of the screen).

4.4. IntervalBar



Interval Bar Example

Progress 2/6

Implement a class, `IntervalBar`, which inherits from `tk.Canvas`. This class should display a horizontal progress bar with vertical lines dividing each `step`, allowing the user to see progress from `0, 1, …, steps-1, steps`, inclusive. For example, in Interval Bar Example above, there are 6 steps and the current progress is 2.

Add the interval bar to the application and increase its progress every time the user makes a move. When maximum progress is reached, reset the progress to for the next turn (it can start at 0 or 1).

`IntervalBar` must be a subclass of `tk.Canvas`. `tkinter.ttk.Progressbar` must not be used.

5. Task 2 – Intermediate Features

The purpose of this task is to extend the functionality of the basic GUI by adding additional dots and companion functionality.

Companions are helpful side characters that can be activated to perform a special ability. Every time a companion dot is activated, the companion is charged (by one). When a companion is fully charged, their ability is activated. Once activated, a companion's charge is reset to zero, ready to be charged again. By default, a companion is fully charged when it has been charged six times.

Add another item to the file menu to allow the user to choose between a New Game either with or without a companion.

5.1. Companion Dot

Companion Dot

Implement the CompanionDot class by extending `BasicDot` in `game.py`, and include it in your game.

It may be helpful to use `CompanionGame` from the `game.py` file. During development of the companion dot, it may be helpful to use `UselessCompanion`. A custom companion will be implemented in the next section.

5.2. Dot & Companion

Implement the following, and add them to your game:

- Any **one** dot from 8.1. Dot Options
- Any **one** companion from 8.2. Companion Options

Some companions require a certain type of dot (i.e. when activated they may place a special type of dot). If you choose such a companion, you should choose the dot it requires as one of your dots.

You should also add an `IntervalBar` to your `InfoPanel` and update it to show how much charge the companion has after each move (this replaces the `IntervalBar` added to the application in 4. Task 1 – Basic GUI).

6. Task 3 – Advanced Features

This task is open ended. It is up to you to decide what to do for this task. Marks will be awarded based on the sophistication of the features you choose to implement. Ensure that you consult with course staff before you commence this task to ensure that the features are sufficiently sophisticated.

You are encouraged to utilize extra Python modules to help you implement your desired functionality.

6.1. Description Document

You must also submit a brief description of the features you have implemented for this task. This must be included in `description.pdf`, along with any other required descriptions — see 9. Assignment Submission. The description for this task should also contain an outline of any third party Python modules you have used, and instructions on how to install them. For example if you have used Pillow module, then the following would be sufficient:

> Version 4.2.1 of Pillow has been used. Install the Pillow module with pip using the command:

```
pip install Pillow
```

If using multiple third–party libraries, it is a good idea to list their names and versions first, using bullet points, and then provide specific installation instructions afterwards.

Be sure to format the description document neatly to ensure that the marker can quickly scan the document for relevant information (i.e. by using larger, bold headings, vertical whitespace between sections, section numbers, etc.).

6.2. Suggestions

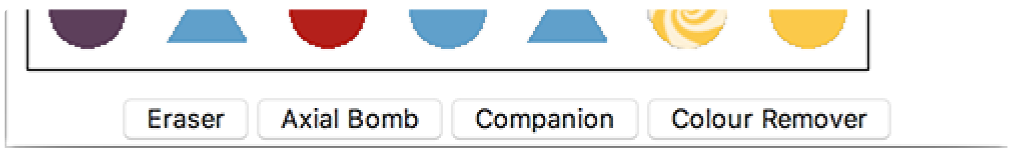
- Saving and loading a game
- Background music/event sounds
- Additional dots & companions
- Campaign style storyline
- Various animations

These suggestions are not necessarily equal in difficulty, and the complexity will likely vary based upon the particular implementation. Students should discuss potential features with course staff prior to implementing them, to get feedback on the sophistication.

7. Post–Graduate — CSSE7030 Only

This task is only required for CSSE7030 students. CSSE1001 students are permitted to attempt this task, but will be not be awarded marks for it. Along with functionality & code quality, robustness of code design will be a major factor in the awarding of marks.

7.1. Action Bar



Action Bar Example

The action bar will allows the user access to special actions. Implement the `ActionBar` class, which inherits from `tk.Frame` and add it to your game.

1. be placed at the bottom of the window, below the game grid,
2. be laid out reasonably, and

3. have a button that activates its action when clicked, for any two (at least) of the following actions:
    - Companion Charge: Immediately activates the companion
    - Colour Remover: Immediately activates (& removes) all dots of a random kind (colour)
    - Eraser*: Allows the user to choose any one dot; activates (& removes) that dot
    - Axial Bomb*: Allows the user to choose any dot; activates (& removes) that dot along with all dots in the same row & column

    *(actions marked with * are more difficult to implement)*

The user should only be able to activate each action once per game.

It is worth noting the overlap of functionality between these actions and the Penguin companion & BeamDot.

7.2. More Dots & Companions

Implement the following:

- Any **two** additional dots from 8.1. Dot Options
- Any **two** additional companions from 8.2. Companion Options

Add a way for the user to choose the companion they want to play with (i.e. a separate menu item for each companion).

Be sure to include a brief description of these in `description.pdf` &mdash see 9. Assignment Submission

8. Dot & Companion Options

If any any dots or companions are implemented, the submission must include a brief description of what has been implemented. This must be included in `description.pdf` — see 9. Assignment Submission

Students may use the supplied images for dots/companions, but may also use images of their own choosing.

Students are also permitted to implement dots/companions of their own choosing, but should discuss this with course staff prior to doing so.

Any dots implemented **must inherit** from `AbstractDot` (or one of its subclasses) in the `dot.py` file. Similarly, any companions implemented **must inherit** from `AbstractCompanion` (or one of its subclasses) in the `companion.py` file. **This is very important**, as these `Abstract` classes define a common interface with all dots/companions (i.e. one can expect that any method defined on `AbstractDot` will also be available on any type of Dot class).

8.1. Dot Options

For the following descriptions, the term `adjacent dots` includes dots that are diagonally adjacent.

ButterflyDot

A butterfly dot starts in a cocoon. The first time an adjacent dot is connected, the coocoon cracks. The second time, the butterfly emerges. The third time, the butterfly dot is activated. When a butterfly dot is activated, it activates all dots a 3-by-3 area around itself. A butterfly dot cannot be selected.

AnchorDot

Anchor dots are activated when they reach the bottom of the grid (the lowest row in their column). Anchor dots cannot be selected.

BalloonDot

Balloon dots appear along the bottom row of the grid, instead of the top. After each turn a balloon dot will swap positions with the dot above it. When a Balloon dot reaches the top row, it will be activated. Balloon dots cannot be selected.

TurtleDot

After each turn the turtle randomly swaps with an adjacent dot. When a dot adjacent to the turtle is connected the turtle hides in its shell. When hiding the turtle does not move and if another adjacent dot is connected it be activated.

FlowerDot

When a flower dot is activated, it will automatically connect to all adjacent dots within its reach that are of the same kind (colour).

SwirlDot

When activated, the swirl dot changes the kind (colour) of adjacent dots to its kind.

BeamDot

Beam dots can be orientated horizontally, vertically, or both. When a beam dot is activated, it will activate all dots along the same horizontal and vertical axis

WildcardDot

Included in `dot.py`
Wildcard dots do not have a kind (colour), but can be connected to any other kind of dot.

8.2. Companion Options

EskimoCompanion

Randomly places a few swirl dots on the grid.
Requires: SwirlDot

BuffaloCompanion

Randomly places a few wildcard dots on the grid.
Requires: WildcardDot

CaptainCompanion

Randomly places a few beam dots on the grid.
Requires: BeamDot

AristotleCompanion

Randomly places a few butterfly dots on the grid.
Requires: ButterflyDot

DeerCompanion

Randomly places a square of dots on the grid. The dots will be the kind (colour) of the most common kind on the board.

GoatCompanion

Randomly selects a few dots and changes their kind (colour) to the most common kind of dot on the grid.

PenguinCompanion

Selects a random kind (colour) of dot from the grid, and activates all dots of that kind. *This is the most difficult companion, because it requires animation*

9. Assignment Submission

Note: There will not be a practical interview for the third assignment.

Your assignment must be submitted via the assignment three submission link on Blackboard. You must submit a zip file, `a3.zip`, containing `a3.py` and all the files required to run your application (including images). You may omit the support code — if you do so, the most recent version will be used. If you have attempted a relevant task, this zip file must also contain your `description.pdf` file.

Late submission of the assignment will **not** be accepted. In the event of exceptional circumstances, you may submit a request for an extension.

All requests for extension must be submitted on the UQ Application for Extension of Progressive Assessment form: http://www.uq.edu.au/myadvisor/forms/exams/progressive-assessment-extension.pdf **at least 48 hours prior** to the submission deadline. The application and supporting documentation must be submitted to the ITEE Coursework Studies office (78–425) or by email to enquiries@itee.uq.edu.au.

Change Log

Any changes to this document will be listed here.

Version 1.1.2 - October 25

- Bugfixes:
  - Game moves no longer hardcoded to 20
  - Corrected return type in `AbstractDot.activate`'s docstring

    - Fixed missing objectives after reset
- Made size optional for `load_image` functions and moved to `util.py`
- Clarified `IntervalBar` in 4.4. IntervalBar & 5.2. Dot & Companion
- Clarified when 4.2. InfoPanel should be updated

Version 1.1.1 - October 8

- Added `CompanionGame` class to `game.py`

Version 1.1.0 - October 8

It is recommended that you **immediately** update your support code, download the new `a3.py` and copy your progress into it

Assignment Sheet

- Fixed typographical errors
- Added images to 8.1. Dot Options
- Added 8.2. Companion Options
- Reduced difficulty:
  Any extras previously implemented will count towards 6. Task 3 – Advanced Features
    - Reduced to one dot (from two) in 5.2. Dot & Companion
    - Reduced to two actions (from four) in 7.1. Action Bar
- Added description of Remaining Moves label in 4.2. InfoPanel

Support Code

- Significantly improved animation mechanics (heavy modifications to `game.py`) and dependencies
- `dot.py`:
    - `AbstractDot`: Removed `__eq__`; Added `after_resolved`, `can_connect`, `will_be_removed`, `PRIORITY`
    - Added `AbstractKindlessDot`, `WildcardDot`
- Tweaked `AbstractCompanion.activate`'s docstring (added yield)
- Corrected docstring for `ObjectivesView.draw`
- Major modifications to `a3.py`:
    - Added some suggestions (search file for "useful")
    - Renamed `DotsApp._score` to `_refresh_status` and removed parameter
    - Removed `DotsApp._animate,` `remove`
    - Other modifications: `DotsApp._connect`, `_drag`, `_drop`
    - Events: Removed `activate`, `animate`; Added `reset`

- Added animation delays for each step type (see `ANIMATION_DELAYS` in `a3.py`)
- Moved some classes from `game.py` to `cell.py`, `factory.py`