EEE3096S Embedded Systems II Test 1 Memo

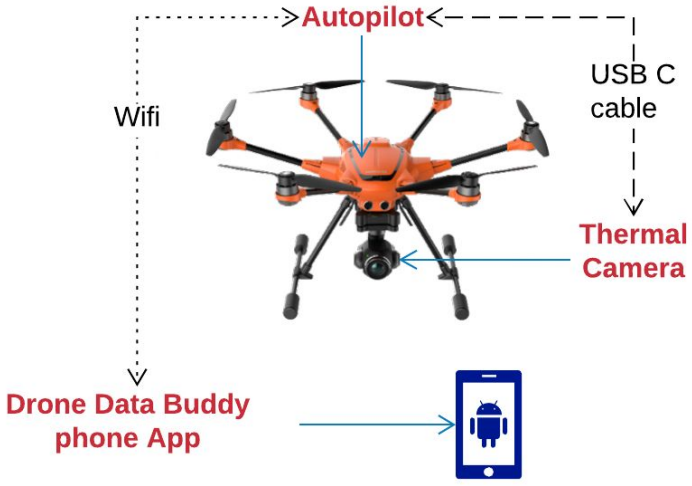
Section A: Long answers [40]

This section tests ELO 5 and must be passed, we strongly recommend you complete it first.

This question relates to the following system design scenario. Read the design description closely and then answer the questions that follow. In all questions use diagrams and text however you see best just ensure diagrams are well labeled.

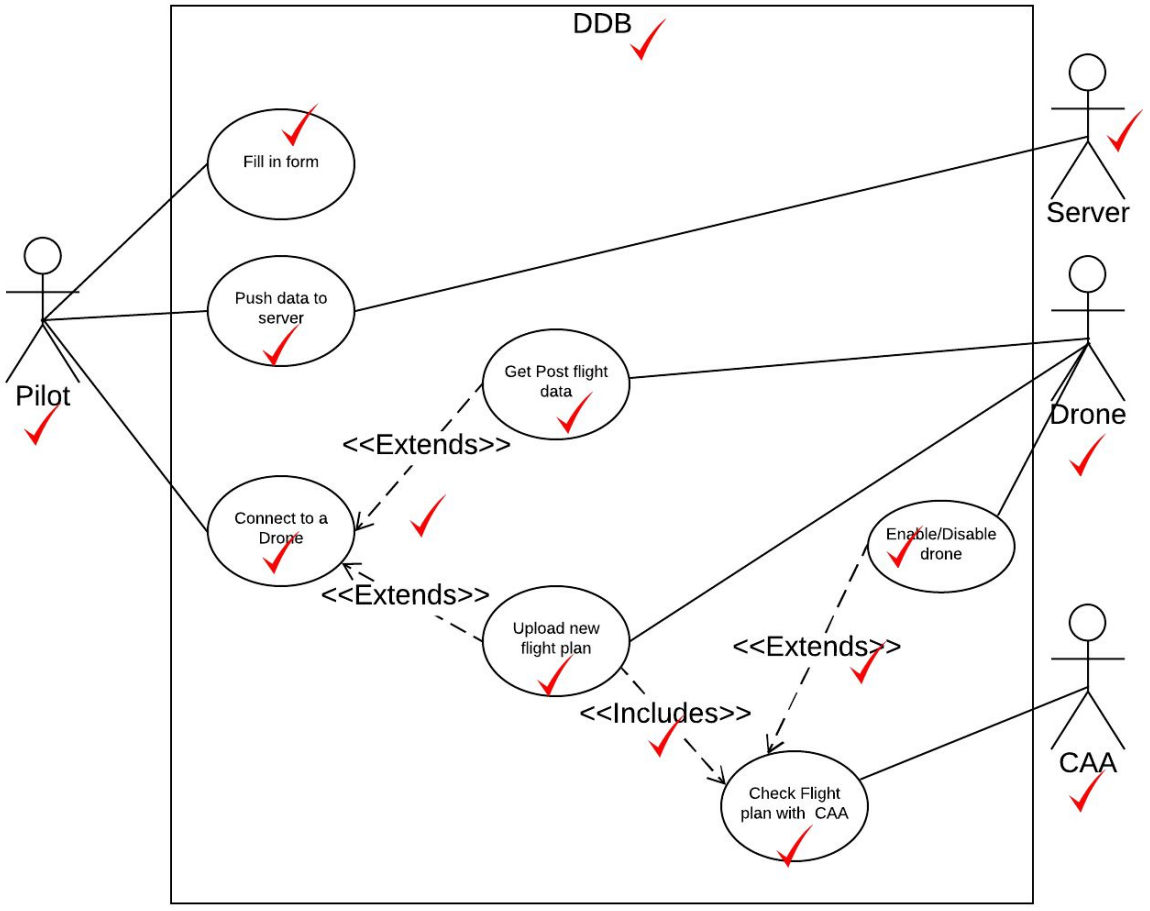
Drone Data Buddy (DDB) Phone App: When using a drone to capture scientific data a lot of extra information is needed beyond what the sensor captures (eg: wind speed, pilot license number etc) and clearance from the local airspace authority is often needed. Capturing all this information and getting flight permission is often tedious. You have been asked to develop a Phone App to make these tasks easier for drone pilots for a client who hopes to sell the app and cloud services. The client currently has a working relationship with the South African Civil Aviation Authority (CAA) who give drone pilots flight permission based on flight plans, but they might be able to expand to also working with the USA Federal Aviation Authorities soon too.

At your first client meeting you are told DDB must enable the following/offer a drone pilot the following services:
(1) Allow the pilot to enter ground information (eg current weather conditions etc) into a form and save it. (2) Allow the pilot to connect to a drone over wifi and either download post flight data to the phone or upload a new flight plan to the drone. (3) When the pilot uploads a new flight plan to the drone DDB will automatically first send the flight plan to the relevant local civil aviation authority and query if the drone has permission to fly it. Depending on if permission is granted or not the drone will either be put into a enabled or disabled state. (4) Allow the pilot to choose to upload the ground information forms and any sensor data from a flight to a backend server over 3G.



Additionally, you are told that the process the DDB app should follow for checking in with the civil aviation authority is as follows: Check the flight plan take off location is within 100m of the phone's GPS location and determine if the flight will be within restricted or unrestricted airspace. If the flight is in unrestricted airspace the aviation authority does not need to be notified and the drone should simply be enabled and the process is complete. If the flight is in restricted airspace, however, the flight plan must be submitted to the aviation authority who will then either grant or deny flight permission. If approved again the drone should be enabled and the process completes, or if denied the drone must be diabled and then the process completes.

1. Draw a use case diagram for the Drone Data Buddy App described above. Use formal UML diagram syntax. (Testing ELO) [15 marks]



Marking notes: There are multiple ways this could be drawn, if 15 things are correct give the marks. Most likely there will be additional use cases, and different names used than the model answer. Key things to look for are:

- Pilot, Drone, CAA, and Server actors with Pilot as primary and rest as secondary and DDB being the system (5)
- “Obvious’ uses cases: Ground information, Connect to drone, Get post flight data, Push data to server, Something about new flight plans (5)
- Use cases and extend/include lines indicating some means of automatically (includes) checking with CAA and optionally (extends) enabling/disabling the drone (5)

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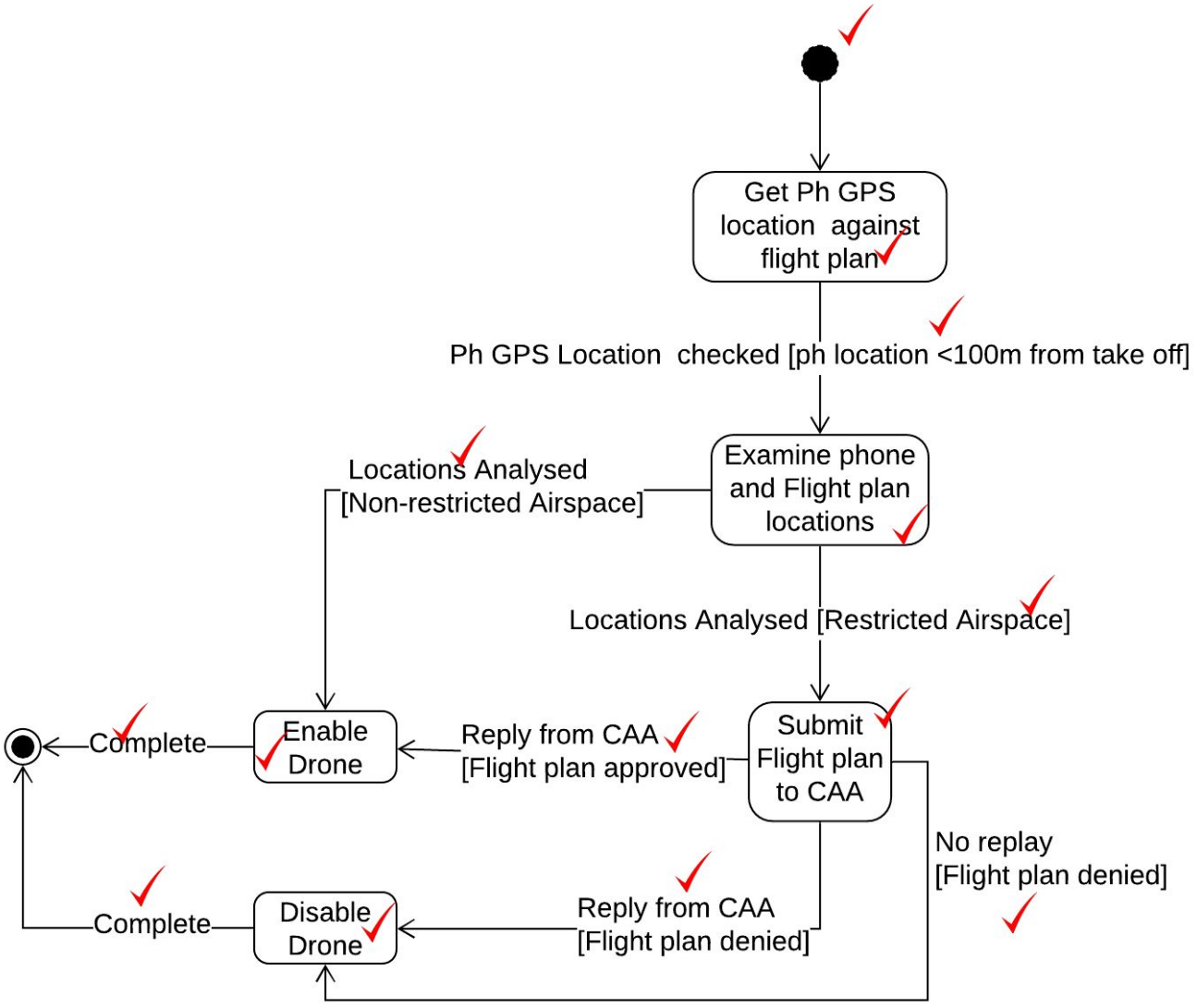
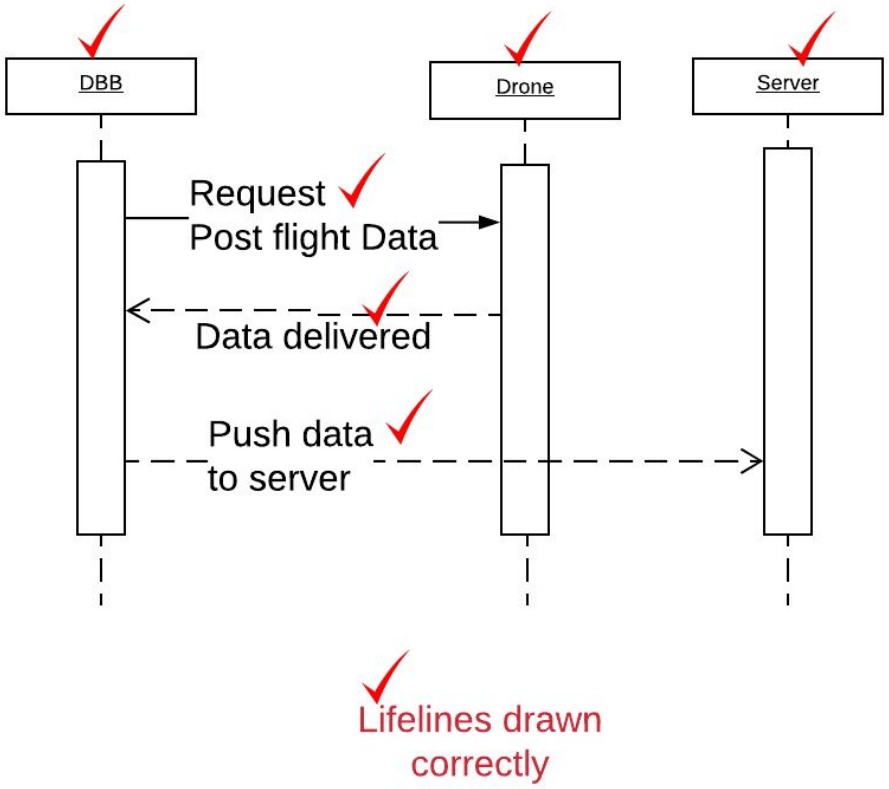
2. Draw a state diagram showing the states needed in the control class of the DDB App **only for the use case of checking the flight plan with the civil aviation authorities and enabling/disabling the drone.** No marks will be given for showing any states for any of the other use cases. Use formal UML diagram syntax including showing start and end, transition triggers and Boolean Gaurd conditions where needed. (Testing ELO) [14 marks]



Marking Notes: Again, it is likely that labels used might be slightly different but if the intended meaning is obvious and correct assign the mark. ½ marks for transitions that only have guard conditions '[...]' or only have trigger can also be given

3. Draw a sequence diagram showing only how the DDB will get post flight data from the drone and upload it to a backend server for storage. Use formal UML diagram syntax. (Testing ELO) [7 marks]

Marking Note: If labels are slightly different but correct meaning is obvious assign the marks



4. You have a team of 10 engineers and designers who you will manage to build DDB. As their manager, describe why and how you would use the Agile design process rather than the Waterfall design process over the year long period you and the team will be building Drone Data Buddy App. Hint: The drone industry is evolving and changing at a very fast rate and is highly competitive. [4 marks]

Text does not need to be exact at all but marks given for student demonstrating some understanding of any 3 of these and how it relates/is relevant to the DDB project needs:

- Agile enabling change in the design at a later date
- Agile being a responsive a changing market
- Agile enabling an early product release even if it's buggy to start with
- Agile facilitating team work well
- Waterfall being very linear and not a process that allows change at a later date
- Waterfall not allowing early product release

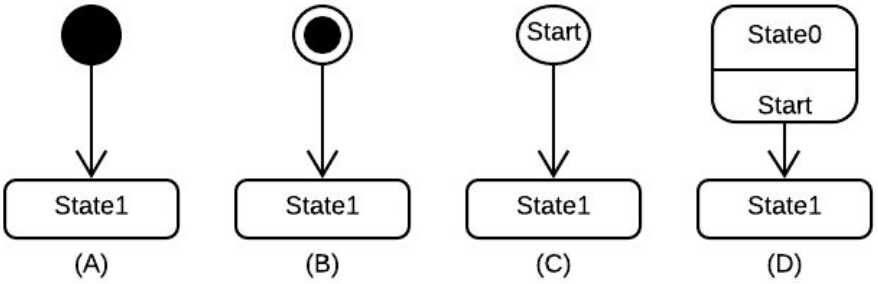
Eg: The Agile design process is well suited to a development pipeline that might require the design change as it is responsive and enables change throughout development, additionally it facilitates team work well. This is more appropriate for the given project than the waterfall design process which does not readily enable change at a later date in the design as it is very linear and assumes you know everything at the start of the design process which in not the case with DDB.

Section B: Multiple choice, choose the **most correct** answer. Circle the letter of your answer below [18]

I. A Moore Machine…(select 1) [3 marks]

A. has outputs determined solely by its current state.
B. has outputs determined by its inputs and current state.
C. has outputs determined solely by its inputs.
D. generally has fewer states than Mealy Machine.

II. Which one of the below states indicates a state chart initial state? [3 marks]



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III. The number of quantization levels of an ADC depends primarily on? [3 marks]

A. The DNL error, The INL error, and The offset error of the ADC
B. The Power consumption of the ADC.
C. The type of ADC.
D. The input analog signal range, ADC Voltage Reference, and The resolution of the ADC.

IV. In ADC data sheets the minimal change in signal voltage required to guarantee a change in the output code level is referred to as the: [3 marks]

A. INL
B. DNL
C. LSB
D. DAC

V. When benchmarking different computing systems it can be important to use a technique known as “cache warming” in order to get useful results. Cache warming is used because: [3 marks]

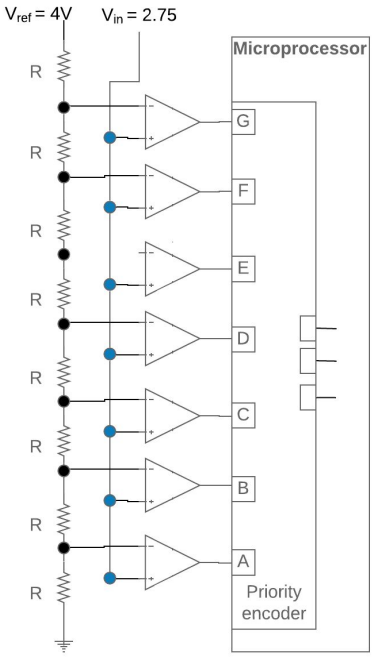
A. As the system temperature rises its speed increases and you want the benchmark to run at peak speed.
B. You wish to compare only how the CPUs performs at a specific task without considering the size and speed of the available system memory or caching algorithms.
C. To fill the cache with non-relevant data as you wish to test the performance of the system memory.
D. You intend to operate your selected device at high temperatures as it will be deployed in high temperature environments and need the benchmark results to represent this.

VI. How would you link your local git repository to a Github repository? [3 marks]

A. $ git init github
B. $ git remote add username@github.com:username/myrepo.git
C. $ git remote new username@github.com:username/myrepo.git
D. $ git link username@github.com:username/myrepo.git

Section C: Short answers [12]

1. What is the output ABCDEFG of the flash ADC shown below? [4 marks]



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2. What is the voltage resolution of the Flash ADC in B.1 [2 marks]

0.5V

3. What is the primary reason a designer is likely to select a Flash ADC over a Ramp or Successive Approximation ADC when a high digital resolution is needed? [2 marks]

Flash ADC is must faster than SAR and Ramp which have time to completion times proportional to the number of digital bits required.

4. The following C code segment has been written to execute on a Pi using the WiringPi Library. Briefly describe what it's functionality is: [4 marks]

```
pinMode(5, INPUT);
pullUpDnControl(5, PUD_UP);
wiringPiISR (5, INT_EDGE_FALLING, &launchDrone);
```

- Sets pin 5 to be used as an input
- Sets the internal resistor to be a pull up
- Creats an interrupt on pin 5
- The interrupt triggers on a falling edge and calls the launchDrone() function