

Midterm Exam, Mobile Computing Spring 2017

Name: _____

Question 1: Assume that you're programming a solitaire (card) game using the Model-View-Controller (MVC) design. For each of the following activities, identify which MVC component should implement the appropriate action by writing "M", "V", or "C" on the line to the left.

- _____ React to user taps on the touchscreen
- _____ Determine if a move the user is trying to make is legal
- _____ Shuffle the card deck (i.e., randomize the order of the cards)
- _____ Show an animation of the deck being shuffled

Question 2: What is the primary advantage of two-way ToA over one-way ToA?

Question 3:

(a) Why does GPS work well in rural areas but not in urban/indoor areas?

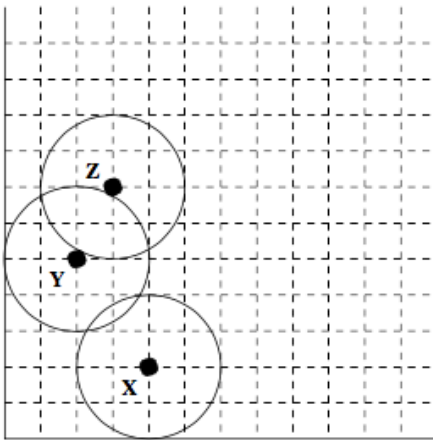
(b) Why does Wi-Fi fingerprinting work well in urban/indoor areas, but not in rural areas?

Question 4: A device **A** transmits a beacon signal at time 1000 (measured using **A**'s clock), which is received by a device **B** at 2000 (measured using **B**'s clock). Device **B** then responds with a signal at 2500 (using its own clock), which is then received by **A** at 3300 (using its own clock).

(a) What is the distance computed by node **A** if the signal velocity is 1m per 100 time units?

(b) What can you say about the synchronization of the two devices?

Question 5: Two nodes **A** and **B** do not know their own positions, but they can hear beacons in their proximities. Node **A** can hear beacons located at (4,2) and (2,5). Node **B** can hear beacons located at (2,5) and (3,7). All nodes have a radio range of 2 units (see figure below; the beacon nodes are indicated as **X**, **Y**, and **Z** and the circles show the radio ranges).



(a) Are either (3,3.5) or (3,4.5) possible locations for node **A**? Explain.

(b) Are either (2,6) or (4,5) possible locations for node **B**? Explain.

Question 6: Why are three satellites enough to obtain a position on the globe?

Question 7: Assume that you have to design a very simple ADC with 4 bits. How many different steps (“levels”) does your ADC have? If the voltage range is 0-8V, what is the “step size” in Volts?

Question 8: Circle either T (True) or F (False) for the statements below:

- T F** The reason we sometimes lose GPS signal in urban areas is that the GPS receiver cannot send location requests to enough GPS satellites.
- T F** RFID tags periodically transmit some form of identifier that can be received by RFID reader devices.
- T F** Both accelerometer and gyroscope measure linear acceleration, but the gyroscope is typically more sensitive (i.e., accurate), but also more expensive.
- T F** In the MVC model, the Controller is responsible for interpreting the user’s interactions and to change the data and view correspondingly.
- T F** GPS is based on ranging using RSS (Received Signal Strength).
- T F** In two-dimensional space, trilateration requires at least three beacons to obtain a single/unique position.
- T F** A sensor is called passive if it does not have a radio component.
- T F** A piezoelectric sensor is a resistor that changes its resistance based on physical pressure.
- T F** If a given GPS location is true within 20m in 90% of all measurements, the accuracy is 20m.

Question 9: Passive RFID does not have a battery. Where does the energy come from? Which hardware component inside a passive RFID device is responsible for obtaining the energy needed for communication?

Question 10: Choose the right answer (there is only one correct answer per question).

_____ The GPS system requires that:

- a. All satellites have atomic clocks
- b. All receivers have atomic clocks
- c. A receiver has visibility of a GPS satellite for at least 3 minutes to get a fix
- d. All of the above
- e. None of the above

_____ The purpose of DGPS and WAAS is to:

- a. Increase the range of GPS signals
- b. Support localization based on Wi-Fi fingerprinting
- c. Improve the accuracy of cell-based localization
- d. None of the above

_____ The GPS master control and monitor stations are used to:

- a. Transmit radio signals to receiver devices with a correction factor
- b. Serve as additional beacon (instead of a satellite) if there are not enough satellites visible to a receiver device
- c. Determine satellite errors and transmit correction information to satellites
- d. None of the above

_____ An accelerometer can be used to

- a. Determine linear acceleration, tilt angle of a device, and gravity
- b. Is always less accurate than a gyroscope
- c. Uses changes in the magnetic field caused by metal to determine a device's position
- d. All of the above

Question 11: Imagine a mobile app that allows you to find and read about sport venues. Describe three different types of context information that could be used to make the app “better”. Briefly explain how you would obtain such context information (e.g., which sensors, user-provided preferences, etc.).