CSI 5169 Wireless Networks and Mobile Computing Quiz 1, February 18, 2011

Closed book exam, time: 100 minutes

Name: _____ Student number: _____

Marking:

Q	1	2	3	4	5	6	7	8	9	10	11
Max mark	6	6	4	6	9	6+6	10	7+5	9	5+5	8+8

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1. What is the major difference between CSMA/CD and CSMA/CA with respect to collision treatment?

CSMA/CD runs backoff timer after detection of a collision whereas CSMA/CA runs the backoff timer before a collision occurrence to avoid it.

2. Why RFID poses privacy risks for consumers and enterprises?

Small RFID tags are attached to many items and can be attached to human. RFID readers everywhere can extract the location and private items by reading these tags.

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3. Who is the 'father' of radio/wireless communications? The same person invented transformers for long distance transfers of alternate current, and electric motors, which enabled the use of electricity everywhere.

Nikola Tesla

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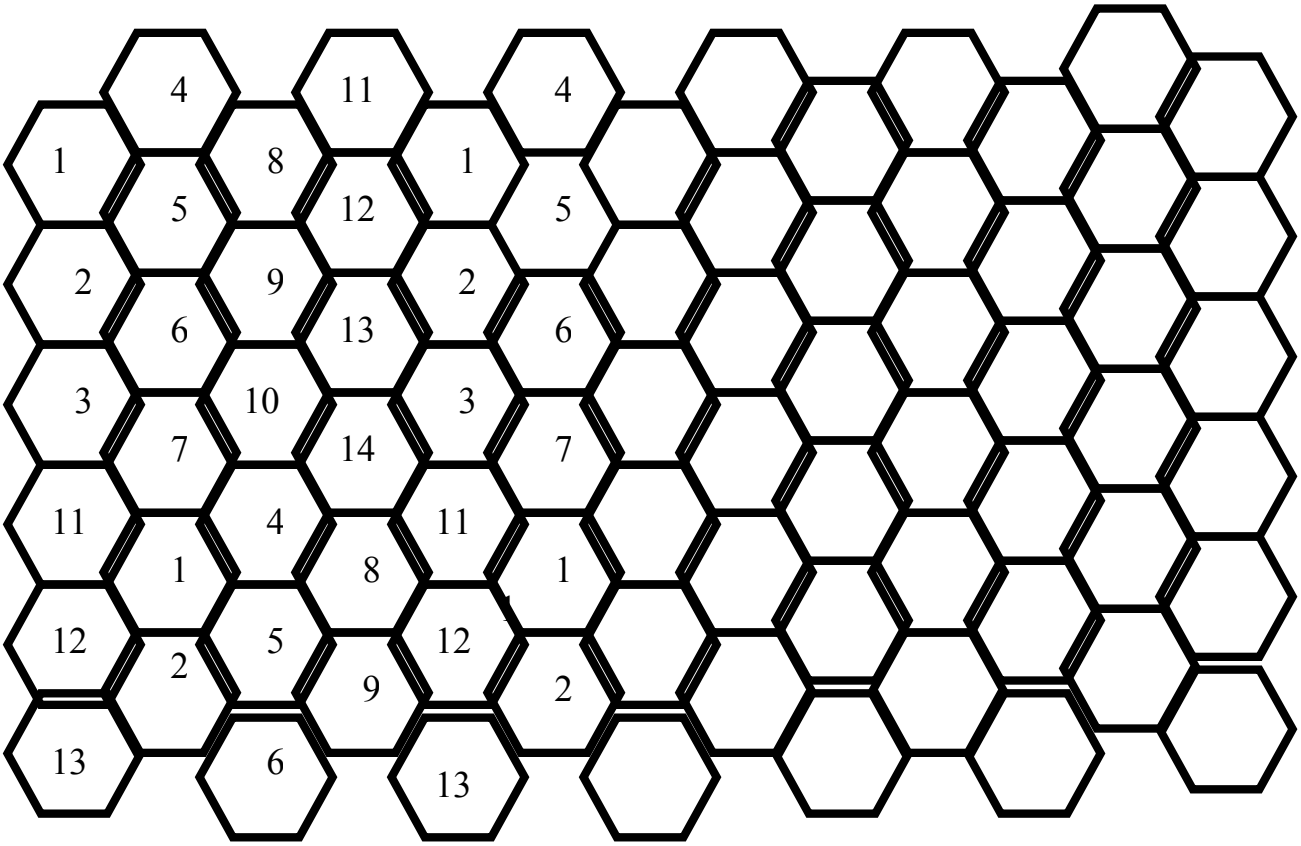
4. Show on examples how MACA (Multiple Access with Collision Avoidance) avoids hidden terminal and exposed terminal problems.

See class notes 'Media access' slide 3.

5. Suppose that a station has selected its backof time B in DCF (Distributed Coordinated Function) mode of IEEE 802.11, and channel became busy after initial DIFS period. Explain how the station can decrement B and when it can be allowed to transmit?

Station will decrement B each time it observes an idle time spot (no messages). It will retransmit in the next slot after B becomes 0.

6. Show frequency allocation patterns with reuse distances 4, using minimal number of colors. Use numbers as colors.



7. Suppose there are only two passive tags to be read by an RFID reader following protocol 2-partition-1. It works as follows (actual algorithm is simplified to be applied only on two tags):

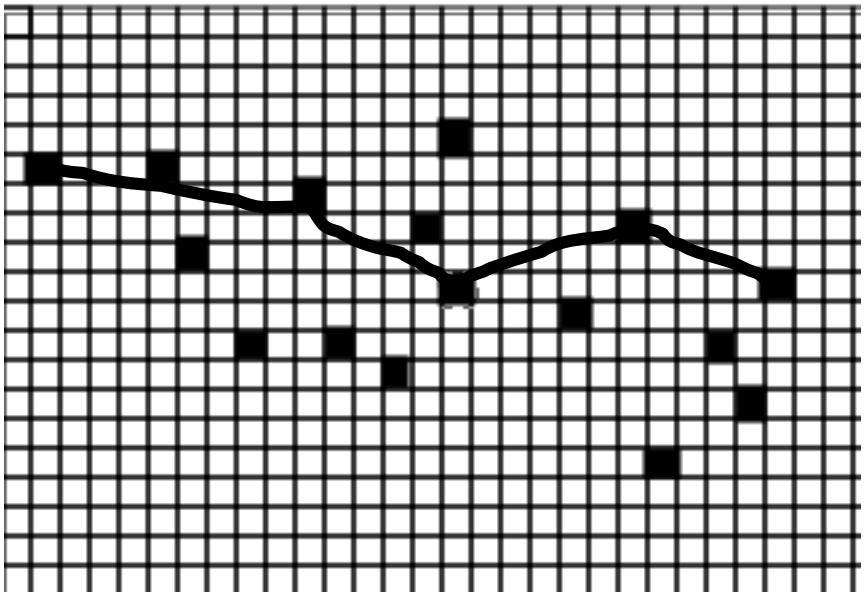
nextId=0;
Repeat
repeat *each tag selects 0 or 1 with probability 1/2;*
active tag that selected 1 broadcasts → Status1
until *Status1 <> silence;*
if *Status1=single* ***then*** *{ NextId ← NextId + 1 };*
active tag that selected 0 broadcasts → Status0;
if *Status0 = single* ***then*** *{ NextId ← NextId + 1};*
until *NextId=2;*

a) What is the probability of getting unique tag transmission?
b) What is the expected number of rounds (reader requests for ID) for this event to occur?
c) What is the expected number of rounds (reader requests for ID) to read both tags?

a) There are four outcomes: 00, 01, 10, 11. Unique tag occurs in two of them, with probability 2/4=0.5.
b) The expected number of rounds is 1/p=1/0.5= 2.
This is equal to 1*(1/2)+ 2*(1/4)*3*(1/8)+4*(1/16)+…

c) It takes two rounds to get unique transmisison (from b). In the next round then the other tag will be read (it will be the only one to transmit). Thus the expected number of rounds is 3.

8a. The black squares represent cars. In greedy routing algorithm, message is forwarded to neighbor closest to the destination (and closer to it) among those located within transmission range. Show using arrows how messages can be transmitted from the leftmost car to the rightmost car. Assume the transmission range to be 10. Distance between two cars is measured by counting the number of number of squares between them (consecutive squares share an edge; therefore two squares, sharing only a corner, are at distance 2).



8b) Give an example of a situation where greedy algorithm you use fails, although source and destination cars are connected.

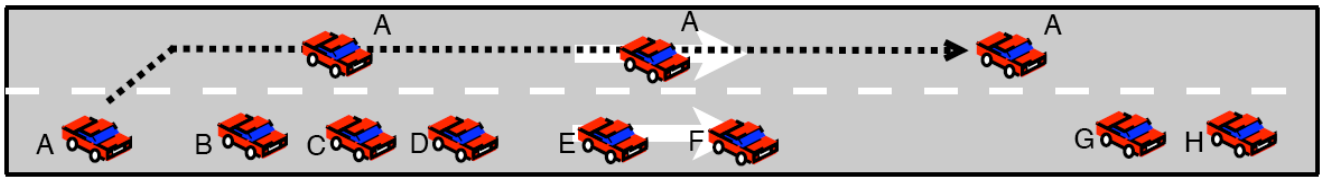
For example, imagine a ring of nodes, and greedy decided to traverse upper semi-circle, and after few hops there are no more nodes to advance, and greedy algorithm fails. At the same time, lower semi-circle may have enough nodes to connect from source on the left to the destination on the right; however that connection is not used by greedy algorithm.

9. Parameterless reliable broadcasting (Ross, Ruiz, Stojmenovic, 2009) works as follows:

1. Beacons used by cars to decide whether or not they belong to a connected dominating set (CDS).
2. Vehicles in CDS use shorter waiting period before possible retransmissions.
3. Identifiers of circulated broadcast messages are added to beacons as *piggybacked aknowledgements*.
4. When waiting timeout expires, *vehicle retransmits if it has at least one neighbor which did not acknowledge circulated message with the last beacon*, and sets a new waiting period.

In Figure below, there are two clusters: BCDEF and GH, while car A moves as indicated. Suppose that A is the source of a message when it started the maneuvre (at the left end). Also assume that transmisison radius allows eftmost position of A to transmit to B, B to send to C and D, D to E only, E to F, and G to H (this is symmetric of course). CDS nodes are B,D,E and H. Which cars retransmit? How many time A retransmit and at what locations? Explain by tracing the algorithm.

A transmits first, received by B, B transmits, received by C and D, D in CDS and retrasmits first, received by E, E transmits, received by F, F does not retransmit since it has no other neighbors in need of message. A will receive beacons from nodes B-F informing message received already, so does not retransmit again on that part of travel. When A comes close to G and received beacon from G, it will retransmit message. Then G will retransmit to H. A does not retransmit again since later beacon from H will inform that message was already received.



10. Consider fixed channel allocations with reuse distance 2. Let D be the maximum number of channels ever needed in a node or 3-cycle (triangle of base stations).
a) explain briefly the allocation of 3D/2 channels to accommodate all calls, and how is this achieved (borrowing scheme).
b) explain briefly the allocation of 4D/3 channels to accommodate all calls, and how is this achieved (borrowing scheme).

See answer on two slides from the notes on Channel assignment.

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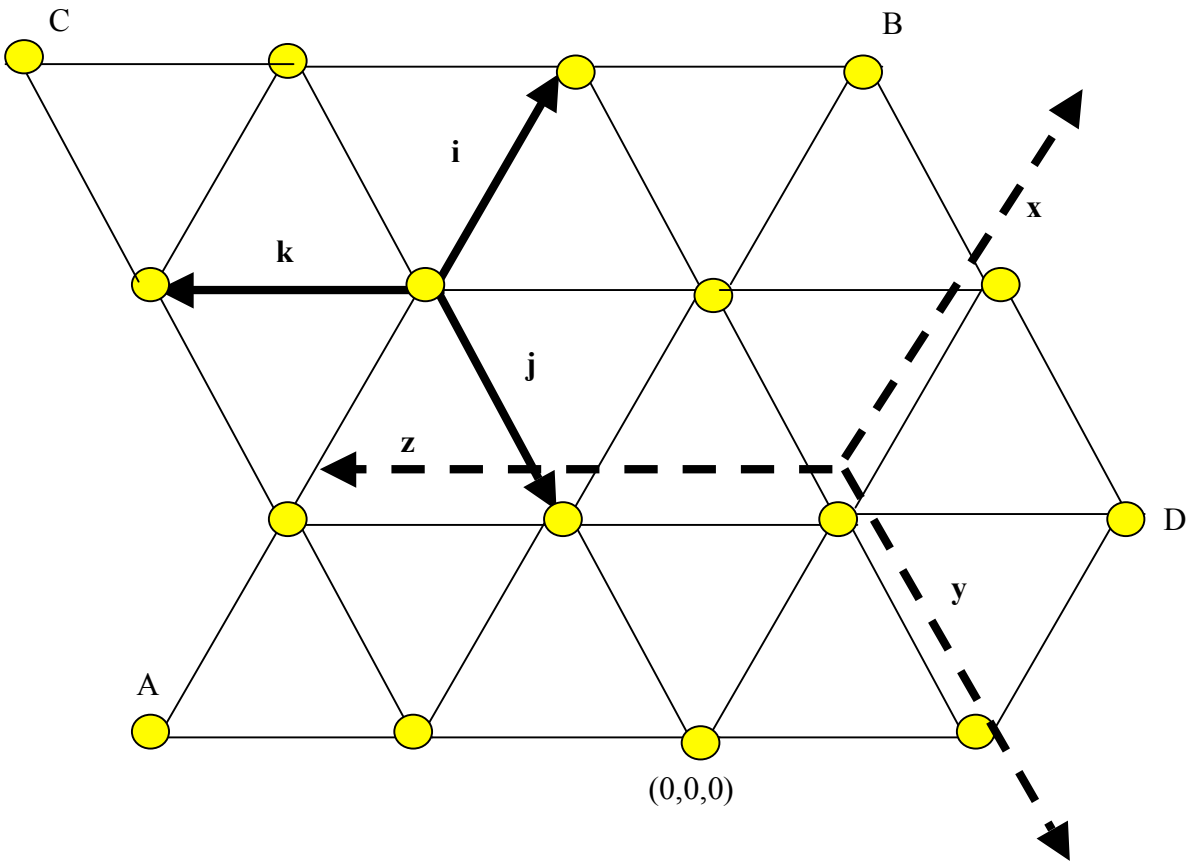
11.



a) What are the coordinates of nodes A, B, C and D in the unique shortest path representation?
b) Give necessary and sufficient condition for (a,b,c) to be a unique shortest path representation of a node. Explain briefly this condition (no need for technical derivations).

a) A: (0,0,2), B(2,-1,0), C(0,-3,1), D(1,-1,0).

b) (a,b,c), conditions are abc=0, ab<=0, ac<=0, bc<=0. So at least one is 0, and two others cannot be both positive or both negative. If say both a and b are positive (ab>0), then (1,1,0) can be replaced by shorter path (0,0,-1). This can be repeated few times until we get ab<=0; in fact one of them at least will become 0.