Homework 3

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1.

	Switch	Input Port	Input VCI	Output Port	Output VCI
A→C	1	2	0	3	0
D→B	1	0	0	1	0
	2	3	0	0	0
	3	0	0	3	0
D→I	1	0	1	1	1
	2	3	1	0	1
	3	0	1	2	0
A→B	1	2	1	1	2
	2	3	2	0	2
	3	0	2	3	1
F→J	4	2	0	3	0
	2	1	0	0	3
	3	0	3	1	0
H→A	4	0	0	3	1
	2	1	1	3	0
	1	1	3	2	2

Node F

Dest.	Next
A	C
B	C
C	C
D	C
E	C

3.

Node A

Dest.	Next
B	C
C	C
D	C
E	C
F	C

Node B

Dest.	Next
A	E
C	E
D	E
E	E
F	E

Node C

Dest.	Next
A	A
B	E
D	E
E	E
F	F

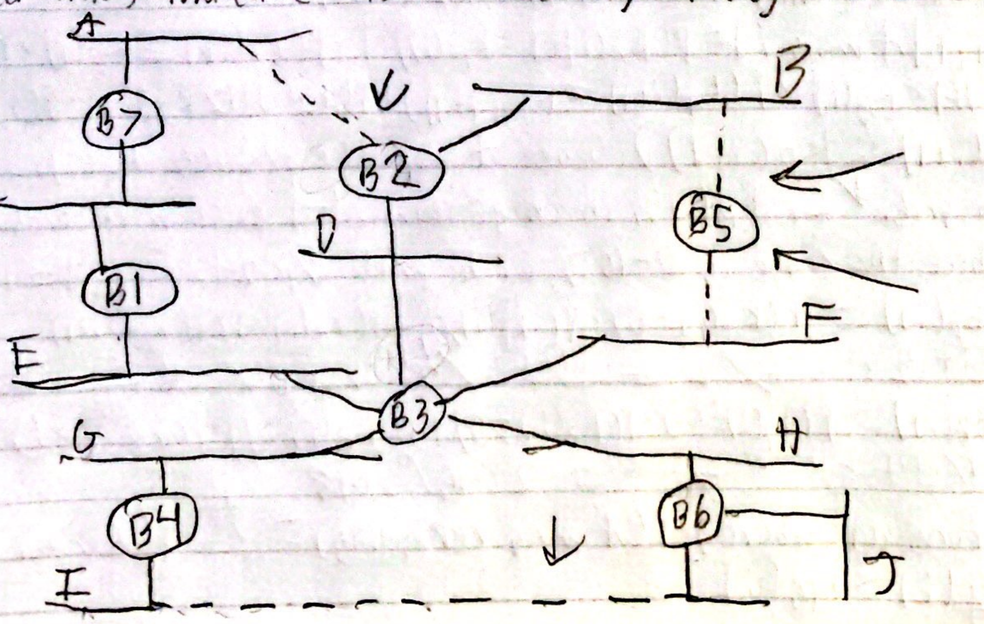
Node D

Dest.	Next
A	E
B	E
C	E
E	E
F	E

Node E

Dest.	Next
A	C
B	B
C	C
D	D
F	C

13. Dotted lines indicate not selected, also, arrows



15. $A \to B1 \to B2 \to B3 \to C, B4 \to D$
$C \to B3 \to B2 \to B1 \to A$
$D \to B4 \to B2 \to B3 \to C$

B1: $A \to A$, $B2 \to C$
B2: $B1 \to A$, $B3 \to C$, $B4 \to D$
B3: $B2 \to A, D$, $C \to C$
B4: $B2 \to A$, $D \to D$

5.A. $P(A \text{ wins}) = P(k_A(2) < k_B(2)) = P(k_A(2) = 0) \cdot P(k_B(2) > 0) + P(k_A(2) = 1) \cdot P(k_B(2) > 1) = \left(\frac{1}{2} \cdot \frac{3}{4}\right) + \left(\frac{1}{2} \cdot \frac{2}{4}\right) = 5/8$

B. $P(A \text{ wins}) = P(k_A(3) < k_B(3)) = P(k_A(3) = 0) \cdot P(k_B(3) > 0) + P(k_A(3) = 1) \cdot P(k_B(3) > 1)$
$= \left(\frac{1}{2} \cdot \frac{7}{8}\right) + \left(\frac{1}{2} \cdot \frac{6}{8}\right) = 13/16$

C. Assume B retries 16 times, after that it gives up. When choosing k between 0 and $2^n - 1$ in exponential backoff, n is capped at 10. So, $P(A \text{ wins remaining}) = \prod_{i=4}^{16} P(A \text{ wins } i \mid A \text{ win } i-1)$. Let $k_A(i)$ be the k value A picks for ith backoff race. Given A wins that race, the prob. of A winning race $i+1$ is 1 if $k_A(i)+1 < k_B(i)$. Assumming the unit of waiting time equals the transmission time,
$P(A \text{ wins } i+1 \mid A \text{ wins } i) = P(k_A(i)+1 < k_B(i)) \cdot 1 + P(k_A(i)+1 \geq k_B(i)) \cdot P(k_A(i+1) < k_B(i+1))$
$\geq P(k_A(i)+1 < k_B(i)) \cdot P(k_A(i+1) < k_B(i+1)) + P(k_A(i)+1 \geq k_B(i)) \cdot P(k_A(i+1) < k_B(i+1))$
$= P(k_A(i+1) < k_B(i+1))$. Since A won the previous, $k_A(i)$ is either 0 or 1, each with prob. $1/2$. $k_B(i)$ is in range $0 \dots 2^i - 1$ each with prob. 2^{-i}, unless $i \geq 10$, where the range is 0–1023, with prob $1/1024$. For $1 \leq i \leq 9$:
$P(k_A(i) < k_B(i)) = P(k_A(i) = 0) \cdot P(k_B(i) > 0) + P(k_A(i) = 1) \cdot P(k_B(i) > 1)$
$= \frac{1}{2} \cdot 2^i - 1/2^i + \frac{1}{2} \cdot 2^i - 2/2^i = 2^{i+1} - 3/2^{i+1}$. For $10 \leq i \leq 16$:
$P(k_A(i) < k_B(i)) = P(k_A(i) = 0) \cdot P(k_B(i) > 0) + P(k_A(i) = 1) \cdot P(k_B(i) > 1)$
$= 1/2 \cdot 2^{10} - 1/2^{10} + \frac{1}{2} \cdot 2^{10} - 2/2^{10} = 2045/2048$
So, from formula above, $P(A \text{ wins remaining}) = \prod_{i=4}^{16} P(A \text{ wins } i \mid A \text{ win } i-1)$
$> \prod_{i=4}^{16} P(k_A(i) < k_B(i))$

$$= \prod_{i=4}^{9} P(k_A(i) < k_B(i)) \cdot \prod_{i=10}^{16} P(k_A(i) < k_B(i))$$

$$= \prod_{i=4}^{9} \frac{2^{i+1}-3}{2^{i+1}} \cdot \prod_{i=10}^{16} \frac{2045}{2048} \approx 0.82 = \text{Lower bound}$$

D. B_1 will be dropped, and B will try the next frame B_2