Formula Sheet

Data representation

IEEE 754 single precision floating point format (binary32):
1 bit sign, 8 bits exponent (bias value 127), 23 bits mantissa
UTF-8 encoding:

From	To	# bytes	Bits used	Byte 1	Byte 2	Byte 3	Byte 4
U+0000	U+007F	1	7	0xxxxxxx			
U+0080	U+07FF	2	11	110xxxxx	10xxxxxx		
U+0800	U+FFFF	3	16	1110xxxx	10xxxxxx	10xxxxxx	
U+10000	U+10FFFF	4	21	11110xxx	10xxxxxx	10xxxxxx	10xxxxxx

Logic rules

- Commutative: $a \vee b \equiv b \vee a$, $a \wedge b \equiv b \wedge a$
- Associative: $a \vee (b \vee c) \equiv (a \vee b) \vee c$, $a \wedge (b \wedge c) \equiv (a \wedge b) \wedge c$
- Distributive: $a \vee (b \wedge c) \equiv (a \vee b) \wedge (a \vee c)$, $a \wedge (b \vee c) \equiv (a \wedge b) \vee (a \wedge c)$
- Identity: $a \wedge T \equiv a$, $a \vee F \equiv a$
- Domination: $a \wedge F \equiv F$, $a \vee T \equiv T$
- Idempotent: $a \wedge a \equiv a$, $a \vee a \equiv a$
- Complement or negation: $a \vee \neg a \equiv T$, $a \wedge \neg a \equiv F$
- Absorption: $a \vee (a \wedge b) \equiv a$, $a \wedge (a \vee b) \equiv a$
- De Morgan's: $\neg(a \vee b) \equiv \neg a \wedge \neg b$, $\neg(a \wedge b) \equiv \neg a \vee \neg b$
- Involution: $\neg\neg a \equiv a$
- Implication law: $a \to b \equiv \neg a \vee b$
- Equivalence law: $a \leftrightarrow b \equiv (a \to b) \wedge (b \to a)$

Probability distributions

Binomial or Bernoulli distribution

If p is the probability of success, $q = 1 – p$ is the probability of failure. The probability of k successes in n repeated trials is given by

$$P(X = k; n, p) = \binom{n}{k} p^k q^{n-k}$$

where X is the random variable corresponding to X = "number of times a successful outcome occurs".

Poisson distribution

$$P(X = k) = e^{-\lambda}\frac{\lambda^k}{k!}$$

where $\lambda = np$ is the expected value and e = 2.71828... (Euler's number)

Geometric distribution

The formula for the k^{th} trial being a success, where the probability of success is p, is:

$$P(X = k) = (1 - p)^{k-1}p$$

Hypergeometric distribution

For the urn problem with red/white balls:

$$P(X = r) = \frac{C(R, r)C(W, n - r)}{C(R + W, n)}$$

where $C(R, r)C(W, n - r)$: the number of ways to pick r red balls from R+W balls

$C(R + W, n)$: the number of ways to pick n balls from R+W balls

Dijkstra's algorithm

1. Mark all nodes unvisited. Create a set of all the unvisited nodes called the unvisited set.
2. Assign to every node a tentative distance value: set it to zero for our initial node and to infinity for all other nodes. Set the initial node as current.
3. For the current node, consider all of its unvisited neighbours and calculate their tentative distances through the current node. Compare the newly calculated tentative distance to the current assigned value and assign the smaller one. Otherwise, keep the current value.
4. When we are done considering all of the unvisited neighbours of the current node, mark the current node as visited and remove it from the unvisited set. A visited node will never be checked again.
5. If the destination node has been marked visited (when planning a route between two specific nodes) or if the smallest tentative distance among the nodes in the unvisited set is infinity (when planning a complete traversal; occurs when there is no connection between the initial node and remaining unvisited nodes), then stop. The algorithm has finished.
6. Otherwise, select the unvisited node that is marked with the smallest tentative distance, set it as the new "current node", and go back to step 3.