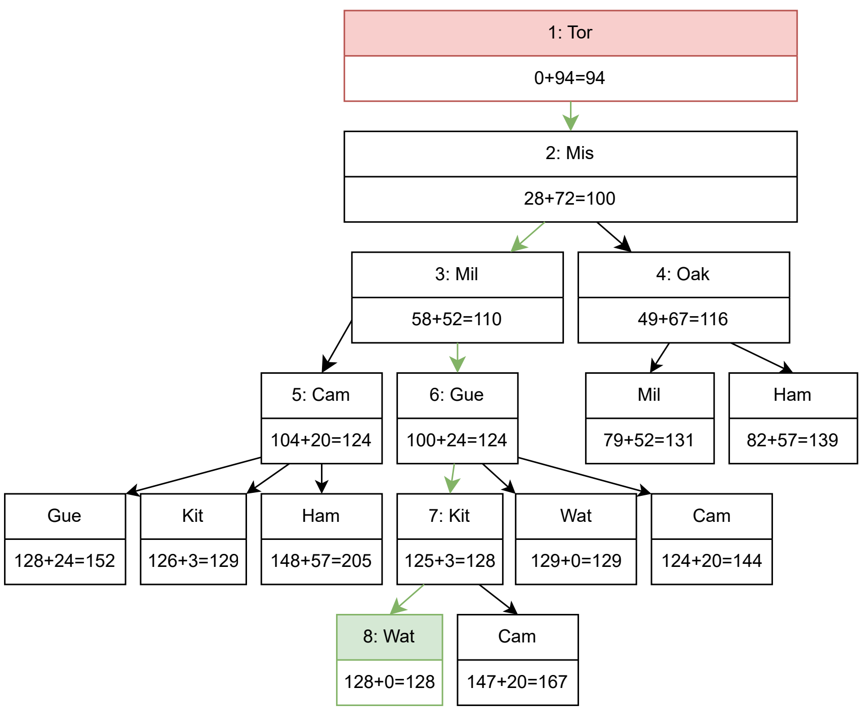
University of Waterloo
CS 486, Winter 2024
Assignment 1

Problem 1

a) The Euclidean distance to the destination is an admissible heuristic function because it never overestimates the actual shortest path cost, as the shortest possible path between two cities is the straight line (Euclidean) distance between them, thus the only possible case is the Euclidean distance equals or **underestimates** the shortest path cost.

b) The Euclidean distance to the destination is a consistent heuristic function because it satisfies the monotone restriction: **heuristic estimate of the path cost is always less than or equal to the actual cost**. As previously stated the Euclidean distance could only equals or **underestimates** the shortest path cost.

c) Decision Tree:



Problem 2

a)

b)

c)

Problem 3

1) We will denote the i'th Queen's coordinate in the form (X_i, Y_i). And the domain for them is $1 \leq X_i \leq N$ and $1 \leq Y_i \leq N$ for all $i \in \{1, 2, \ldots, N\}$.

And the constraints are:

- Row Constraint: $X_i \neq X_j$ for all $i \neq j$ where $i, j \in \{1, 2, \ldots, N\}$.
- Column Constraint: $Y_i \neq Y_j$ for all $i \neq j$ where $i, j \in \{1, 2, \ldots, N\}$.
- Diagonal Constraint: $|X_i - X_j| \neq |Y_i - Y_j|$ for all $i \neq j$ where $i, j \in \{1, 2, \ldots, N\}$.

2) We will denote the i'th Octopi's coordinate in the form (X_i, Y_i). And the domain for them is $1 \leq X_i \leq N$ and $1 \leq Y_i \leq N$ for all $i \in \{1, 2, \ldots, N\}$.

And the constraints are:

- Row Constraint: $X_i \neq X_j$ for all $i \neq j$ where $i, j \in \{1, 2, \ldots, N\}$.
- Column Constraint: $Y_i \neq Y_j$ for all $i \neq j$ where $i, j \in \{1, 2, \ldots, N\}$.
- Block Constraint: $\left\lfloor \frac{X_i - 1}{M} \right\rfloor \neq \left\lfloor \frac{X_j - 1}{M} \right\rfloor$ or $\left\lfloor \frac{Y_i - 1}{M} \right\rfloor \neq \left\lfloor \frac{Y_j - 1}{M} \right\rfloor$ for all $i \neq j$ where $i, j \in \{1, 2, \ldots, N\}$.