

Pràctica 1: Cerca informada

Intel·ligència Artificial (IA)

Estats i operadors

Estats:

El nombre de caselles disponibles al mapa ($n.files * n.columnes$).

Operadors:

- Amunt
- Dreta
- Avall
- Esquerra

Sempre que no se surtin del plànol, llavors aquells operadors no estaran disponibles.

Heurístiques

Economic

Cerca el camí menys costos en l'àmbit monetari entre l'estat inicial i el final. Aquesta heurística calcula la mitja del preu dels transports disponibles i la multiplica per la distància al node destí¹. Per poder acabar de distingir entre dos nodes a la mateixa distància se li suma el cost monetari d'aquell transport. Si es dona el cas que dues caselles amb el mateix transport es troben a la mateixa distància tindrà preferència el primer que s'afegeixi a la llista.

Aquesta heurística no és admissible en certs casos. Ja que utilitzem la mitja dels transports, si trobem un camí on tots els transports que figuren el seu valor és inferior al de la mitja s'haurà sobreestimat i per tant no serà vàlid.

Fast

Cerca el camí menys costos en l'àmbit temporal entre l'estat inicial i el final. Es calcula de la mateixa forma que l'anterior però s'utilitza la mitja del temps dels transports disponibles i per distingir entre dos nodes a la mateixa distància se li suma el cost temporal d'aquell transport.

Tampoc podem assegurar que sigui admissible per les mateixes raons que el cas anterior.

¹ Distància es basa en la geometria del taxista. Ja que no estan permesos els moviments en diagonal. https://en.wikipedia.org/wiki/Taxicab_geometry

Best Option

Aquesta heurística fa un ús de les dos anteriors intentant cerca el millor camí en relació amb temps, preu. Calcula la mitja de les dos anteriors heurístiques.

Si les dues heurístiques són admissibles l'agregada també ho serà. Però com que no podem assegurar que les dues anteriors ho siguin, aquesta tampoc.

Implementació

```
public Solution runSearch(Algorithm algorithm, Heuristic heuristic) {
    State startState = new State(origin);
    State endState = new State(destination);
    boolean found = false;

    HashMap<State, State> parents = new HashMap<>();
    HashSet<State> processed = new HashSet<>();
    HashMap<State, Double> distances = new HashMap<>();
    PriorityQueue<State> pending = new PriorityQueue();

    float numberOfTransports = (float) info.size();
    float sumAllPrices = (float) info.values().stream().mapToInt(x ->
((MapCellCost)x).getPrice()).sum();
    float sumAllTimes = (float) info.values().stream().mapToInt(x ->
((MapCellCost)x).getTime()).sum();

    startState.setDistance(0);
    distances.put(startState, new Double(0));
    pending.add(startState);
    State current;

    while (!found && !pending.isEmpty()) {
        current = pending.poll();

        if (!processed.contains(current)) {
            processed.add(current);
            if (current.equals(endState))
                return new Solution(algorithm, heuristic, this, reconstructPath(parents),
processed.stream().map(State::getData).collect(Collectors.toCollection(LinkedList::new)));

            Set<State> neighbors = getNeighbors(current);
            for (State neighbor : neighbors) {
                if (!processed.contains(neighbor)) {
                    double totalDistance, distanceG = 0, distanceH = 0;
                    double manhattanDistance = neighbor.getData().distance(destination);
```

```
        if (algorithm.equals(Algorithm.ASTAR))
            distanceG = current.getDistance();

        switch (heuristic) {
            case ECONOMIC:
                if (algorithm.equals(Algorithm.ASTAR))
                    distanceG += getPrice(neighbor.getData());
                distanceH = (sumAllPrices / numberOfTransports) * manhattanDistance +
getPrice(neighbor.getData());
                break;
            case FAST:
                if (algorithm.equals(Algorithm.ASTAR))
                    distanceG += getTime(neighbor.getData());
                distanceH = (sumAllTimes / numberOfTransports) * manhattanDistance +
getTime(neighbor.getData());
                break;
            case BESTOPTION:
                if (algorithm.equals(Algorithm.ASTAR))
                    distanceG += (getPrice(neighbor.getData()) +
getTime(neighbor.getData())) / 2.0f;
                double distanceH1 = (sumAllPrices / numberOfTransports) *
manhattanDistance + getPrice(neighbor.getData());
                double distanceH2 = (sumAllTimes / numberOfTransports) *
manhattanDistance + getTime(neighbor.getData());
                distanceH = (distanceH1 + distanceH2) / 2.0f;
                break;
        }

        totalDistance = distanceH + distanceG;

        if (totalDistance < distances.getDefault(neighbor, Double.MAX_VALUE)) {
            distances.put(neighbor, totalDistance);
            neighbor.setDistance(totalDistance);
            parents.put(neighbor, current);
            pending.add(neighbor);
        }
    }
}

return null;
}
```

Joc Proves

Per defecte: (“default”)

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4	// Numero de transports
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t,1,3	
w,10,0	
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Resultats

Algorisme	Heurística	Solució	Nodes tractats	Optimitat	
				Time	Price

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Resultats

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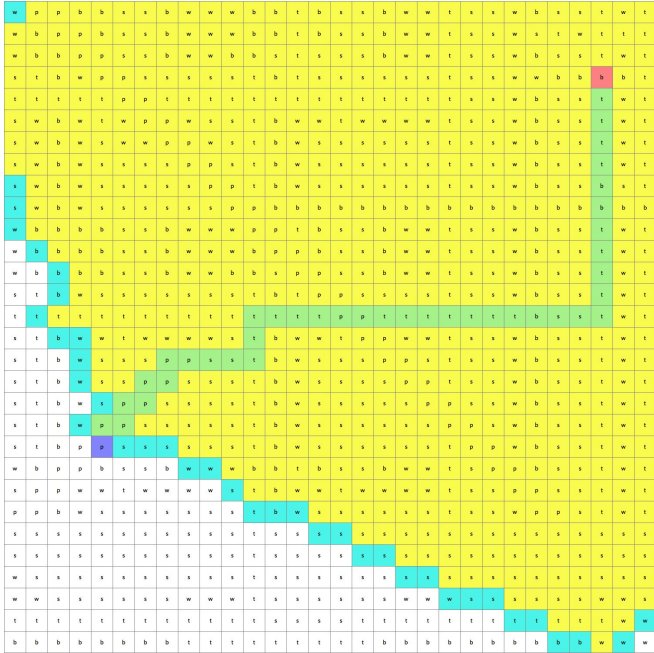
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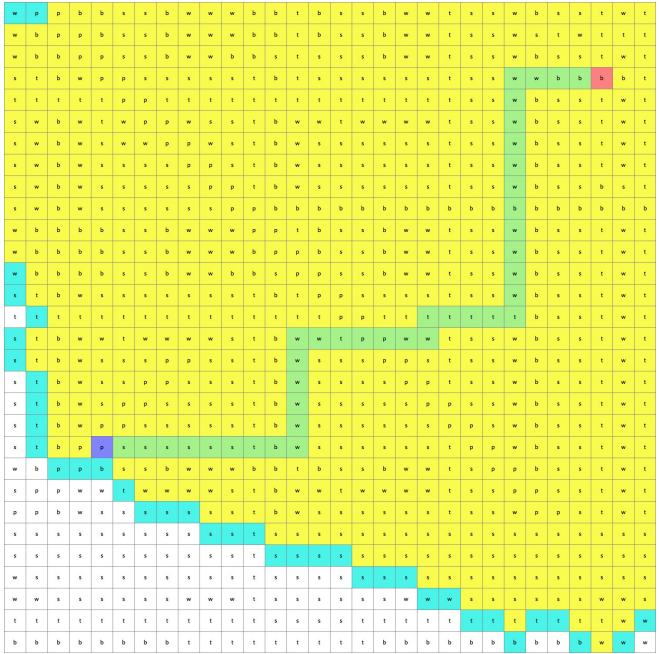
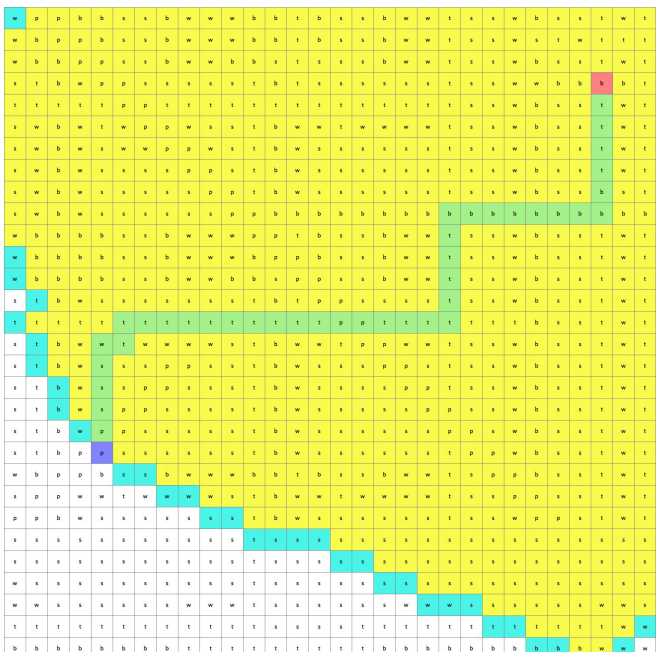
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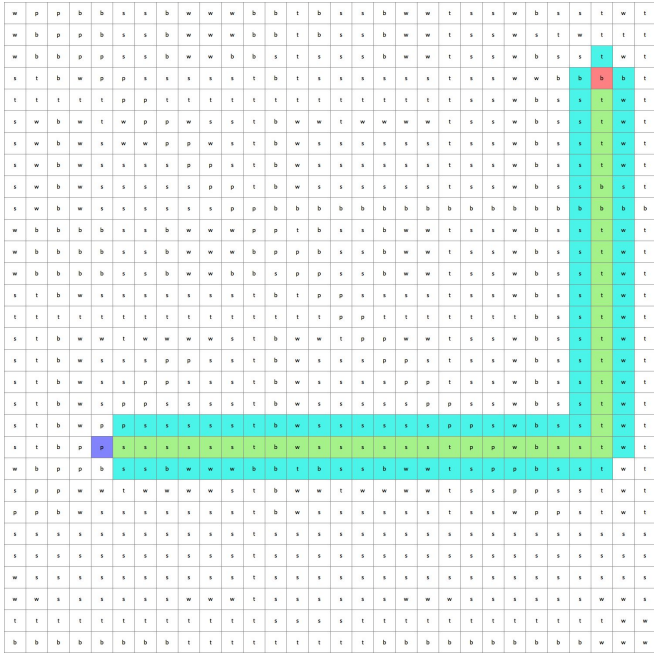
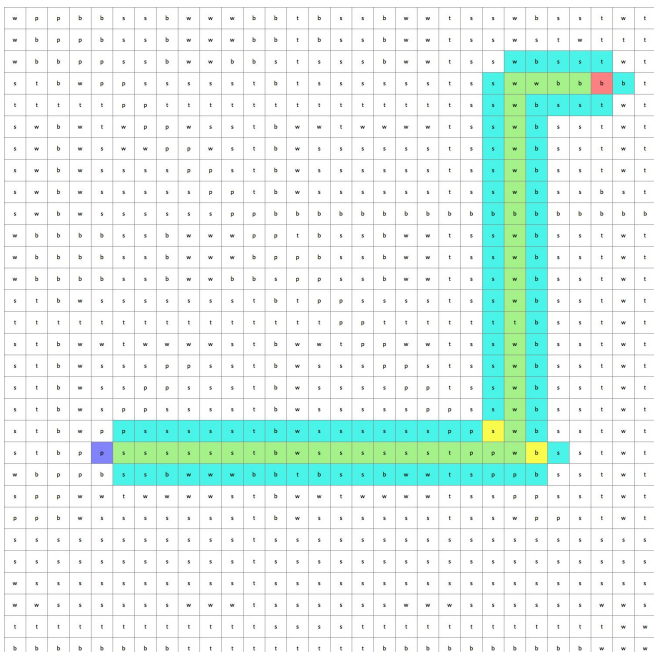
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Resultats

Algorisme	Heurística	Solució	Nodes tractats	Optimitat	
				Time	Price
A*	Fast		691	116	202

	Economic		741	280	89
	Best Option		723	146	142

Best first	Fast		41	178	159
	Economic		43	284	107

	Best Option		41	178	159
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Preguntes

- Per a cada heurística que heu dissenyat, hauríeu trobat la mateixa solució si haguéssiu aplicat hill climbing?

No podem garantir que trobem la mateixa solució, ja que el hill climbing pot quedar-se estancat molt fàcilment en un màxim local, o en un altiplà. Les heurístiques que utilitzem si tenen un factor incremental que ens apropa al node destí. Aquest és la distància de Manhattan, per tant podem deduir que si arribaríem a la mateixa solució.