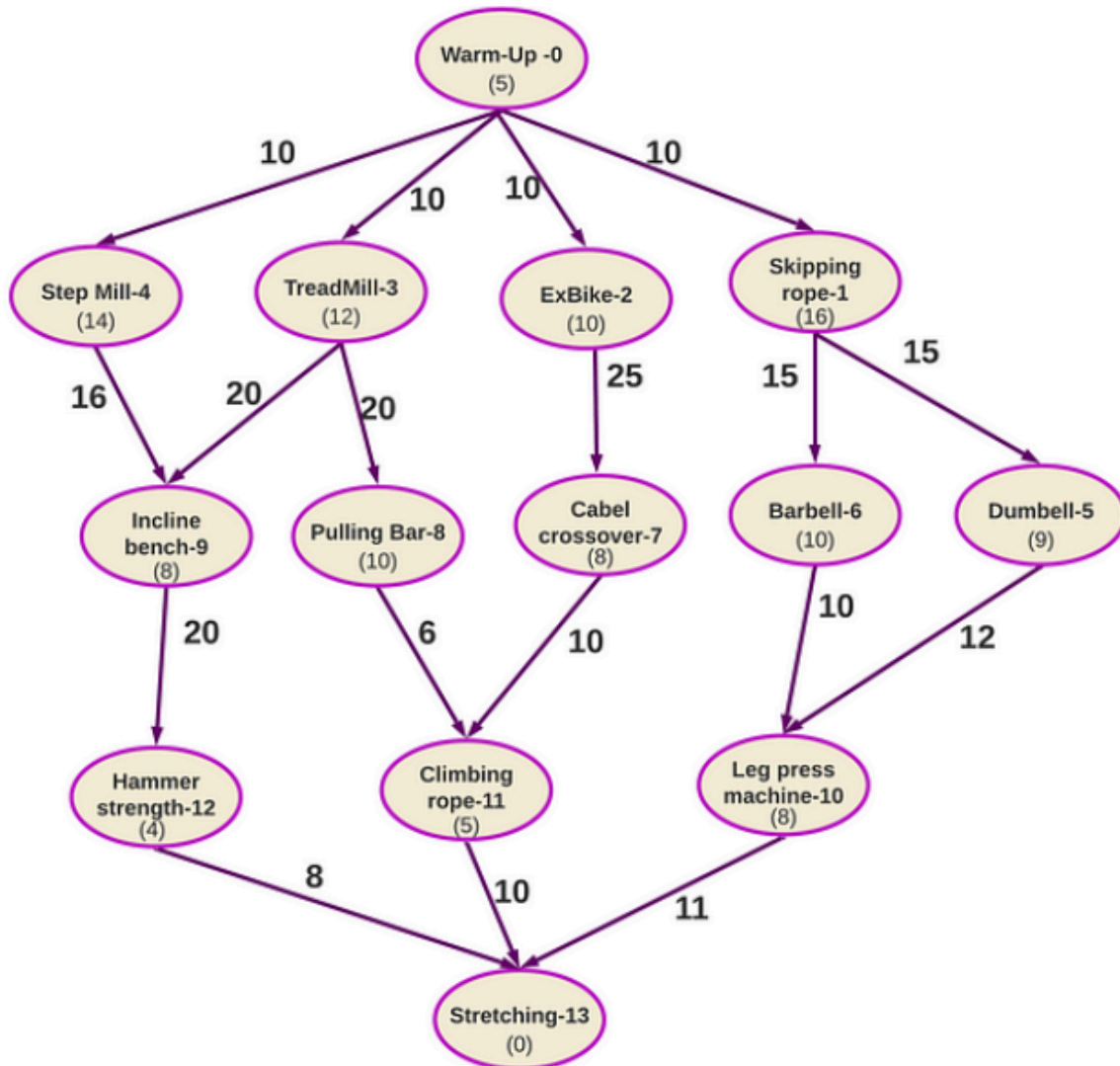


## Inteligencia artificial

### Laboratorio 1



### Ejercicio 1

Algoritmo BFS:

Iteración 1:

Nodo inicial: Warmup

Nodos expandidos: Warmup

Nodos frontier (por expandir): Step Mill, Treadmill, ExBike, Skipping Rope

Costo actual: 10

Iteración 2:

Nodos expandidos: Step Mill, Treadmill, ExBike, Skipping Rope

Nodos frontier: Incline Bench, Pulling Bar, Cable Crossover, Barebell, Dumbell

Costo actual:  $10 + 10 + 10 + 10 + 10 = 50$

Iteración 3:

Nodos expandidos: Incline Bench, Pulling Bar, Cable Crossover, Barebell, Dumbell

Nodos frontier: Hammer Strenght, Climbing Rope, Leg Press Machine

Costo actual:  $50 + 16 + 20 + 20 + 25 + 15 + 15 = 161$

Iteración 4:

Nodos expandidos: Hammer Strenght, Climbing Rope, Leg Press Machine

Nodos frontier: Stretching

Costo actual:  $161 + 20 + 6 + 10 = 197$

Iteración 5:

Nodo expandido: Stretching

**SOLUCIÓN ENCONTRADA**

Secuencia: Warmup -> Treadmill -> Pulling Bar -> Climbing Rope -> Stretching

Costo total:  $10 + 20 + 6 + 10 = 56$

Algoritmo A\*

Heurística: se tomará como la cantidad de repeticiones del ejercicio (el número dentro de paréntesis en cada nodo).

warmup = 5

stepmill = 14

treadmill = 12

exbike = 10

skipping rope = 16  
incline bench = 8  
pulling bar = 10  
cabel crossover = 8  
barbell = 10  
dumbell = 9  
hammer strength = 4  
climbing rope = 5  
leg press machine = 8  
stretching = 0

Iteración 1:

warmup

$g = 0$

$h = 5$

$f = 5$

nodos a expandir : stepmill, treadmill, exbike, skipping rope

Iteración 2:

$f(\text{stepmill}) = 10 + 14 = 24$

$f(\text{treadmill}) = 10 + 12 = 22$

$f(\text{exbike}) = 10 + 10 = 20$

$f(\text{skipping rope}) = 10 + 16 = 26$

nodo a expandir: cabel crossover

Iteracion 3

$f(\text{cabel crossover}) = 10 + 25 + 8 = 43$

se regresa a nivel anterior, nodo a expandir: incline bench , pulling bar

Iteración 4:

$f(\text{pulling bar}) = 10 + 20 + 10 = 40$

$f(\text{incline bench}) = 10 + 20 + 8 = 38$

se regresa a nivel anterior, nodo a expandir: incline bench

Iteración 5:

$f(\text{incline bench}) = 10 + 16 + 8 = 34$

se regresa a nivel anterior, nodo a expandir: barbell, dumbbell

Iteración 6:

$$f(\text{barbell}) = 10 + 15 + 10 = 35$$

$$f(\text{dumbbell}) = 10 + 15 + 9 = 34$$

por jerarquía, nodo a expandir: hammer strength

Iteración 7:

$$f(\text{incline bench}) = 10 + 16 + 20 + 4 = 50$$

nodo a expandir : leg press machine

Iteración 8:

$$f(\text{leg press machine}) = 10 + 15 + 12 + 8 = 45$$

nodo a expandir : leg press machine

Iteración 9:

$$f(\text{leg press machine}) = 10 + 15 + 10 + 8 = 43$$

nodo a expandir: incline bench

Iteración 10:

$$f(\text{incline bench}) = 10 + 20 + 20 + 4 = 54$$

nodo a expandir : climbing rope

Iteración 11:

$$f(\text{climbing rope}) = 10 + 20 + 6 + 5 = 41$$

nodo a expandir: stretching

Iteración 12:

$$f(\text{stretching}) = 10 + 20 + 6 + 10 = 46$$

nodo a expandir: stretching

Iteración 13:

$$f(\text{stretching}) = 10 + 15 + 10 + 11 = 46$$

nodo a expandir: stretching

Iteración 14:

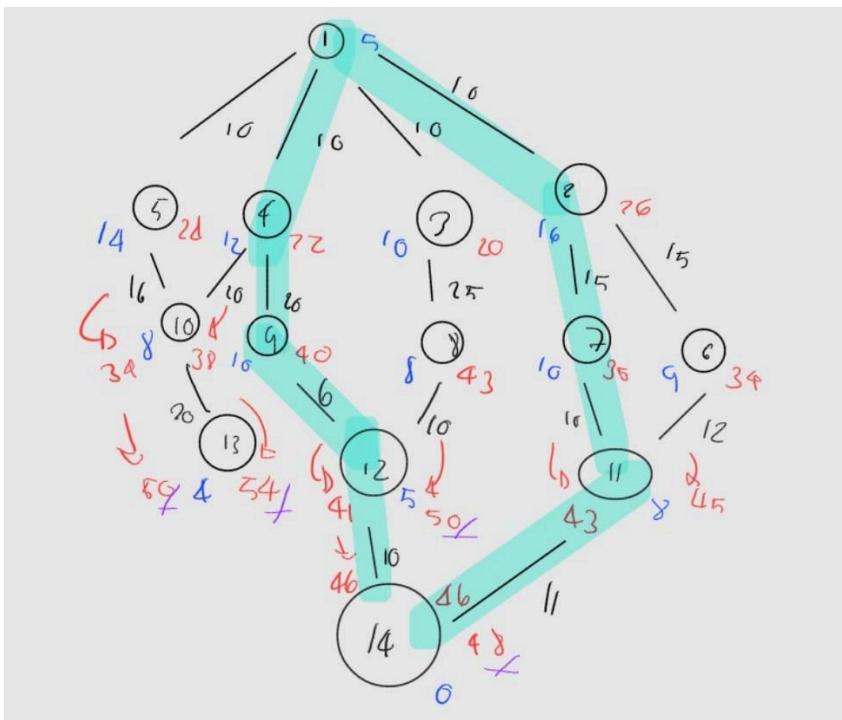
$$f(\text{stretching}) = 10 + 15 + 12 + 11 = 48$$

## SOLUCIONES ENCONTRADAS

warm up -> treadmill -> pulling bar -> climbing rope -> stretching = 46

warm up -> skipping rope -> barbell -> leg press machine -> stretching = 46

Procedimiento a mano:



## Ejercicio 3:

### Algoritmo BFS

```
-----
Explorando nodo: Leg Press Machine
Cola actual: deque([('Climbing Rope', ['Warm-up activities', 'Exercise bike', 'Cable-Crossover']), ('Hammer Strength', ['Warm-up activities', 'Tread Mill', 'Incline Bench']), ('Stretching', ['Warm-up activities', 'Skipping Rope', 'Dumbbell', 'Leg Press Machine'])])
Nodos visitados: {'Barbell', 'Exercise bike', 'Pulling Bars', 'Cable-Crossover', 'Incline Bench', 'Step Mill', 'Warm-up activities', 'Tread Mill', 'Leg Press Machine', 'Skipping Rope', 'Hammer Strength', 'Stretching', 'Dumbbell', 'Climbing Rope'}
Explorando nodo: Climbing Rope
Cola actual: deque([('Hammer Strength', ['Warm-up activities', 'Tread Mill', 'Incline Bench']), ('Stretching', ['Warm-up activities', 'Skipping Rope', 'Dumbbell', 'Leg Press Machine'])])
Nodos visitados: {'Barbell', 'Exercise bike', 'Pulling Bars', 'Cable-Crossover', 'Incline Bench', 'Step Mill', 'Warm-up activities', 'Tread Mill', 'Leg Press Machine', 'Skipping Rope', 'Hammer Strength', 'Stretching', 'Dumbbell', 'Climbing Rope'}
Explorando nodo: Hammer Strength
Cola actual: deque([('Stretching', ['Warm-up activities', 'Skipping Rope', 'Dumbbell', 'Leg Press Machine'])])
Nodos visitados: {'Barbell', 'Exercise bike', 'Pulling Bars', 'Cable-Crossover', 'Incline Bench', 'Step Mill', 'Warm-up activities', 'Tread Mill', 'Leg Press Machine', 'Skipping Rope', 'Hammer Strength', 'Stretching', 'Dumbbell', 'Climbing Rope'}
Explorando nodo: Stretching
```

```
-----BFS ALGORITHM-----
El camino de Warm-up activities a Stretching es: ['Warm-up activities', 'Skipping Rope', 'Dumbbell', 'Leg Press Machine', 'Stretching']
Longitud del camino: 4
Tiempo de ejecución: 0.007727861404418945 segundos
```

### Algoritmo A\*

```
-----
Explorando nodo: Cable-Crossover
Cola actual: [(63, 'Climbing Rope', ['Warm-up activities', 'Tread Mill', 'Pulling Bars']), (70, 'Leg Press Machine', ['Warm-up activities', 'Skipping Rope', 'Dumbbell']), (74, 'Hammer Strength', ['Warm-up activities', 'Tread Mill', 'Incline Bench'])]
Nodos visitados: {'Pulling Bars', 'Leg Press Machine', 'Warm-up activities', 'Dumbbell', 'Hammer Strength', 'Exercise bike', 'Step Mill', 'Tread Mill', 'Cable-Crossover', 'Incline Bench', 'Barbell', 'Climbing Rope', 'Skipping Rope'}
Explorando nodo: Climbing Rope
Cola actual: [(70, 'Leg Press Machine', ['Warm-up activities', 'Skipping Rope', 'Dumbbell']), (74, 'Hammer Strength', ['Warm-up activities', 'Tread Mill', 'Incline Bench']), (73, 'Stretching', ['Warm-up activities', 'Tread Mill', 'Pulling Bars', 'Climbing Rope'])]
Nodos visitados: {'Pulling Bars', 'Leg Press Machine', 'Warm-up activities', 'Dumbbell', 'Hammer Strength', 'Stretching', 'Exercise bike', 'Step Mill', 'Tread Mill', 'Cable-Crossover', 'Incline Bench', 'Barbell', 'Climbing Rope', 'Skipping Rope'}
Explorando nodo: Leg Press Machine
Cola actual: [(73, 'Stretching', ['Warm-up activities', 'Tread Mill', 'Pulling Bars', 'Climbing Rope']), (74, 'Hammer Strength', ['Warm-up activities', 'Tread Mill', 'Incline Bench'])]
Nodos visitados: {'Pulling Bars', 'Leg Press Machine', 'Warm-up activities', 'Dumbbell', 'Hammer Strength', 'Stretching', 'Exercise bike', 'Step Mill', 'Tread Mill', 'Cable-Crossover', 'Incline Bench', 'Barbell', 'Climbing Rope', 'Skipping Rope'}
Explorando nodo: Stretching
```

```
-----A* ALGORITHM-----
El camino de Warm-up activities a Stretching es: ['Warm-up activities', 'Tread Mill', 'Pulling Bars', 'Climbing Rope', 'Stretching']
Longitud del camino: 4
Tiempo de ejecución: 0.00849604606628418 segundos
```

### Algoritmo DFS

```
Cola actual: [('Warm-up activities', [])]
Nodos visitados: set()
Explorando nodo: Warm-up activities
Cola actual: [('Skipping Rope', ['Warm-up activities']), ('Exercise bike', ['Warm-up activities']), ('Tread Mill', ['Warm-up activities']), ('Incline Bench', ['Warm-up activities']), ('Step Mill', ['Warm-up activities'])]
Nodos visitados: {'Exercise bike', 'Skipping Rope', 'Warm-up activities', 'Step Mill', 'Tread Mill'}
Explorando nodo: Step Mill
Cola actual: [('Skipping Rope', ['Warm-up activities']), ('Exercise bike', ['Warm-up activities']), ('Tread Mill', ['Warm-up activities']), ('Incline Bench', ['Warm-up activities']), ('Step Mill', [])]
Nodos visitados: {'Exercise bike', 'Incline Bench', 'Skipping Rope', 'Warm-up activities', 'Step Mill', 'Tread Mill'}
Explorando nodo: Incline Bench
Cola actual: [('Skipping Rope', ['Warm-up activities']), ('Exercise bike', ['Warm-up activities']), ('Tread Mill', ['Warm-up activities']), ('Hammer Strength', ['Warm-up activities']), ('Step Mill', ['Warm-up activities'])]
Nodos visitados: {'Exercise bike', 'Incline Bench', 'Skipping Rope', 'Warm-up activities', 'Step Mill', 'Tread Mill', 'Hammer Strength'}
Explorando nodo: Hammer Strength
Cola actual: [('Skipping Rope', ['Warm-up activities']), ('Exercise bike', ['Warm-up activities']), ('Tread Mill', ['Warm-up activities']), ('Stretching', ['Warm-up activities']), ('Step Mill', ['Warm-up activities']), ('Incline Bench', ['Warm-up activities']), ('Hammer Strength', [])]
Nodos visitados: {'Exercise bike', 'Incline Bench', 'Skipping Rope', 'Warm-up activities', 'Stretching', 'Step Mill', 'Tread Mill', 'Hammer Strength'}
```

```

Explorando nodo: Stretching
-----DFS ALGORITHM-----
El camino de Warm-up activities a Stretching es: ['Warm-up activities', 'Step Mill', 'Incline Bench', 'Hammer Strength', 'Stretching']
Longitud del camino: 4
Tiempo de ejecución: 0.0029938220977783203 segundos

```

## Algoritmo UCS

```

Cola actual: [(35, 'Leg Press Machine', ['Warm-up activities', 'Skipping Rope', 'Barbell']), (36, 'Climbing Rope', ['Warm-up activities', 'Tread Mill', 'Pulling Bars']), (46, 'Hammer Strength', ['Warm-up activities', 'Step Mill', 'Incline Bench'])]
Nodos visitados: {'Exercise bike', 'Tread Mill', 'Warm-up activities', 'Barbell', 'Pulling Bars', 'Dumbbell', 'Climbing Rope', 'Leg Press Machine', 'Hammer Strength', 'Cable-Crossover', 'Incline Bench', 'Step Mill', 'Skipping Rope'}

Explorando nodo: Leg Press Machine
Cola actual: [(36, 'Climbing Rope', ['Warm-up activities', 'Tread Mill', 'Pulling Bars']), (46, 'Hammer Strength', ['Warm-up activities', 'Step Mill', 'Incline Bench']), (46, 'Stretching', ['Warm-up activities', 'Skipping Rope', 'Barbell', 'Leg Press Machine'])]
Nodos visitados: {'Exercise bike', 'Tread Mill', 'Warm-up activities', 'Barbell', 'Pulling Bars', 'Dumbbell', 'Climbing Rope', 'Leg Press Machine', 'Stretching', 'Hammer Strength', 'Cable-Crossover', 'Incline Bench', 'Step Mill', 'Skipping Rope'}

Explorando nodo: Climbing Rope
Cola actual: [(46, 'Hammer Strength', ['Warm-up activities', 'Step Mill', 'Incline Bench']), (46, 'Stretching', ['Warm-up activities', 'Skipping Rope', 'Barbell', 'Leg Press Machine'])]
Nodos visitados: {'Exercise bike', 'Tread Mill', 'Warm-up activities', 'Barbell', 'Pulling Bars', 'Dumbbell', 'Climbing Rope', 'Leg Press Machine', 'Stretching', 'Hammer Strength', 'Cable-Crossover', 'Incline Bench', 'Step Mill', 'Skipping Rope'}

Explorando nodo: Hammer Strength
Cola actual: [(46, 'Stretching', ['Warm-up activities', 'Skipping Rope', 'Barbell', 'Leg Press Machine'])]
Nodos visitados: {'Exercise bike', 'Tread Mill', 'Warm-up activities', 'Barbell', 'Pulling Bars', 'Dumbbell', 'Climbing Rope', 'Leg Press Machine', 'Stretching', 'Hammer Strength', 'Cable-Crossover', 'Incline Bench', 'Step Mill', 'Skipping Rope'}

Explorando nodo: Stretching

```

```

-----UCS ALGORITHM-----
El camino de Warm-up activities a Stretching es: ['Warm-up activities', 'Skipping Rope', 'Barbell', 'Leg Press Machine', 'Stretching']
Longitud del camino: 4
Tiempo de ejecución: 0.008076906204223633 segundos

```

## Algoritmo Greedy first

```

Cola actual: [(0, 'Warm-up activities', [])]
Nodos visitados: set()

Explorando nodo: Warm-up activities
Cola actual: [(10, 'Exercise bike', ['Warm-up activities']), (14, 'Step Mill', ['Warm-up activities']), (12, 'Tread Mill', ['Warm-up activities']), (16, 'Skipping Rope', ['Warm-up activities'])]
Nodos visitados: {'Step Mill', 'Skipping Rope', 'Warm-up activities', 'Tread Mill', 'Exercise bike'}

Explorando nodo: Exercise bike
Cola actual: [(8, 'Cable-Crossover', ['Warm-up activities', 'Exercise bike']), (12, 'Tread Mill', ['Warm-up activities']), (16, 'Skipping Rope', ['Warm-up activities']), (14, 'Step Mill', ['Warm-up activities'])]
Nodos visitados: {'Step Mill', 'Skipping Rope', 'Warm-up activities', 'Tread Mill', 'Cable-Crossover', 'Exercise bike'}

Explorando nodo: Cable-Crossover
Cola actual: [(5, 'Climbing Rope', ['Warm-up activities', 'Exercise bike', 'Cable-Crossover']), (12, 'Tread Mill', ['Warm-up activities']), (16, 'Skipping Rope', ['Warm-up activities']), (14, 'Step Mill', ['Warm-up activities'])]
Nodos visitados: {'Step Mill', 'Skipping Rope', 'Warm-up activities', 'Tread Mill', 'Cable-Crossover', 'Climbing Rope', 'Exercise bike'}

Explorando nodo: Climbing Rope
Cola actual: [(0, 'Stretching', ['Warm-up activities', 'Exercise bike', 'Cable-Crossover', 'Climbing Rope']), (12, 'Tread Mill', ['Warm-up activities']), (16, 'Skipping Rope', ['Warm-up activities']), (14, 'Step Mill', ['Warm-up activities'])]
Nodos visitados: {'Step Mill', 'Skipping Rope', 'Warm-up activities', 'Tread Mill', 'Cable-Crossover', 'Stretching', 'Climbing Rope', 'Exercise bike'}

Explorando nodo: Stretching

```

```

-----GBFS ALGORITHM-----
El camino de Warm-up activities a Stretching es: ['Warm-up activities', 'Exercise bike', 'Cable-Crossover', 'Climbing Rope', 'Stretching']
Longitud del camino: 4
Tiempo de ejecución: 0.0030057430267333984 segundos

```

## Link de repositorio

[https://github.com/Jskenpo/LAB1\\_IA.git](https://github.com/Jskenpo/LAB1_IA.git)

## Discusión

BFS (Breadth-First Search):

- Utiliza más memoria.
- Encuentra la solución más cercana al nodo inicial.

\*A (A-Star)\*\*:

- Utiliza recursos significativos.
- Encuentra la solución óptima en términos de costo.

DFS (Depth-First Search):

- Utiliza menos memoria.
- Encuentra soluciones rápidamente, pero no garantiza la óptima.

UCS (Uniform Cost Search):

- Similar a A\*, pero enfocado en encontrar el camino con el costo más bajo.
- Greedy First:

Utiliza menos recursos.

- Encuentra soluciones rápidamente, pero no necesariamente óptimas.