ENG1003 Freshman Seminar for Engineering
AAE
Design of Path Planning Algorithm for Aircraft Operation

Week 6: Project Goals (design & learning)
Compulsory Tasks

Dr Li-Ta Hsu and Dr Weisong Wen

Assisted by

Man Hei CHENG (Melvin), Miss Hiu Yi HO (Queenie), Miss Yan Tung LEUNG (Nikki)

Tasks of this Freshman Project - GitHub

1. EVERYONE setups a Github account and each group has one Github repository.
2. Invite your TA into your Github repository.
3. Upload every members upload **his/her photo*** into the group Github.
4. Every member contributes his part of the code into the path planning code (can be real code, comments, report or discussion.)

(the assessment of Github part is based on completion of 1, 2, 3 and 4 and activities observed in the Github)

** If you feel offended to upload a photo of yourself, please send me a private email and let me know the reason.*

Tasks of this Freshman Project – Path Planning

1. Find the PolyU aircraft models that achieve the minimum cost for the challenge assigned to your group. (Satisfactory)
2. Design a new aircraft model within the constrains to achieve minimum cost for your group challenge.
   - 2 constraints (Good)
   - 4 constraints with 6 variables (Very Satisfactory)
3. Design a new cost area that can reduce the cost of the route. (Excellence)
4. Additional Tasks (see different slide)

(the assessment of path planning part is based on the completion and the performance of 1, 2, 3 (compulsory) and 4)

Find the PolyU Aircraft Model that achieve minimum cost for the challenge assigned to your group.

Task 1

The PolyU Aircraft Models

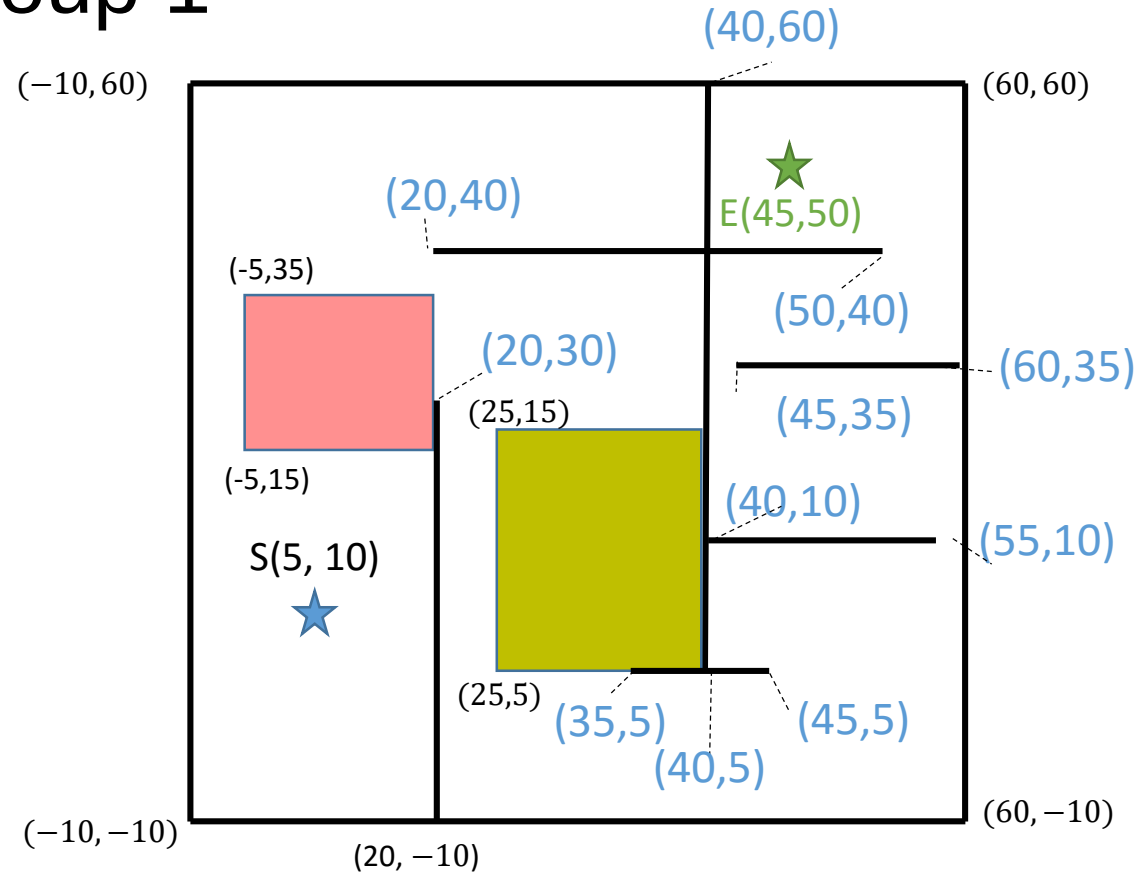
Aircraft Model	C_F	ΔF	C_T	ΔT	C_c	ΔF_a	ΔT_a
PolyU-A380	1	1	2	5	10	0.2	0.2
PolyU-A381	1	1.5	3	5	10	0.3	0.4
PolyU-A382	1	2.0	4	5	10	0.4	0.5
PolyU-A383	1	2.5	5	5	10	0.5	0.1

$$\mathrm{C} = C_F \cdot \Delta F + C_T \cdot \Delta T + C_c$$

With

- C_F=cost of fuel per kg
- C_T=time related cost per minute of flight
- C_c=fixed cost independent of time
- C_T=time related cost per minute of flight
- ΔF=trip fuel (e.g. 3000kg/h)
- ΔT=trip Time (e.g. 8 hours from Hong Kong to Paris)

Group 1



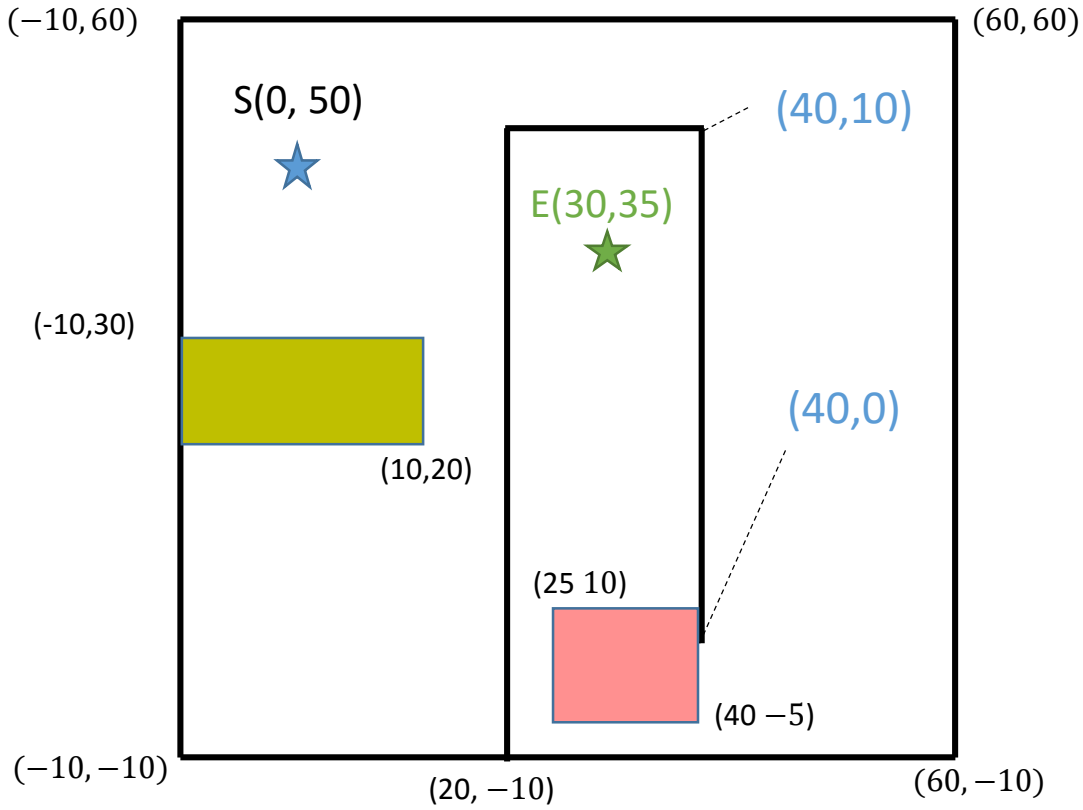
Start node

Goal node

Fuel-consuming area

Time-consuming area

Group 2



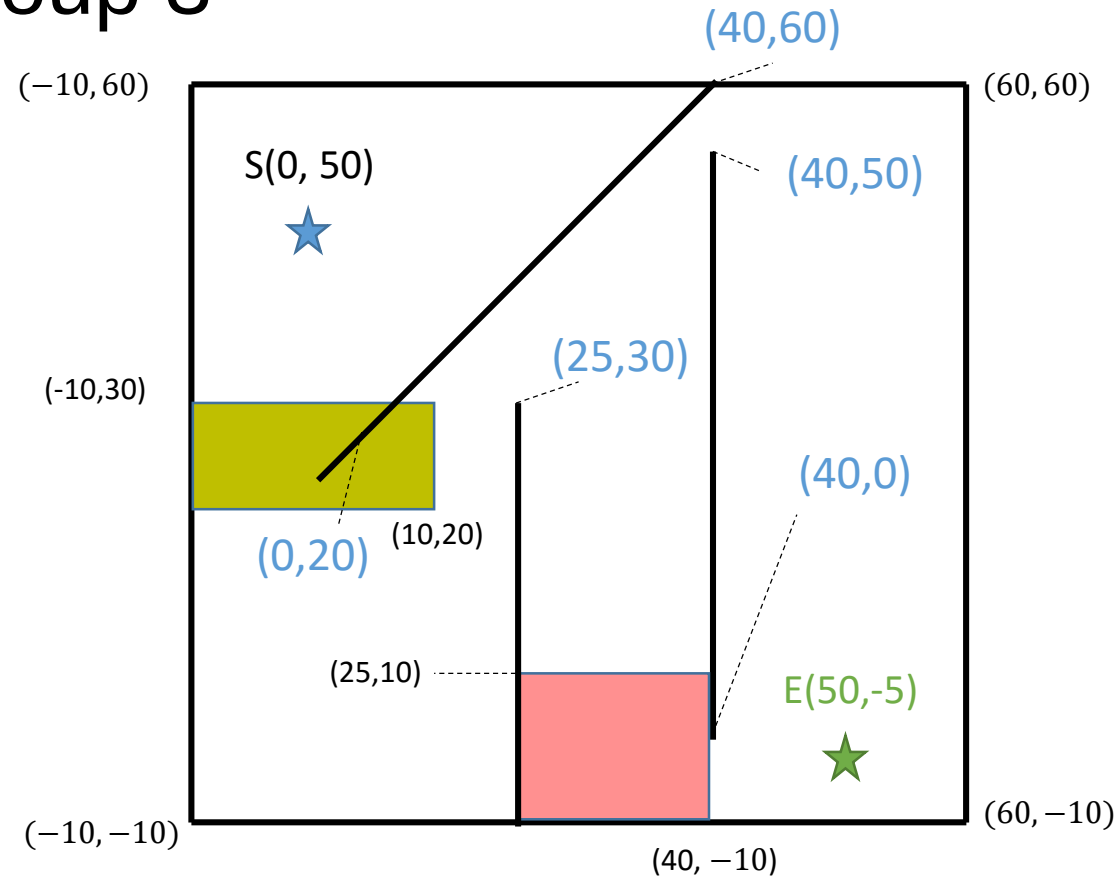
Start node

Goal node

Fuel-consuming area

Time-consuming area

Group 3



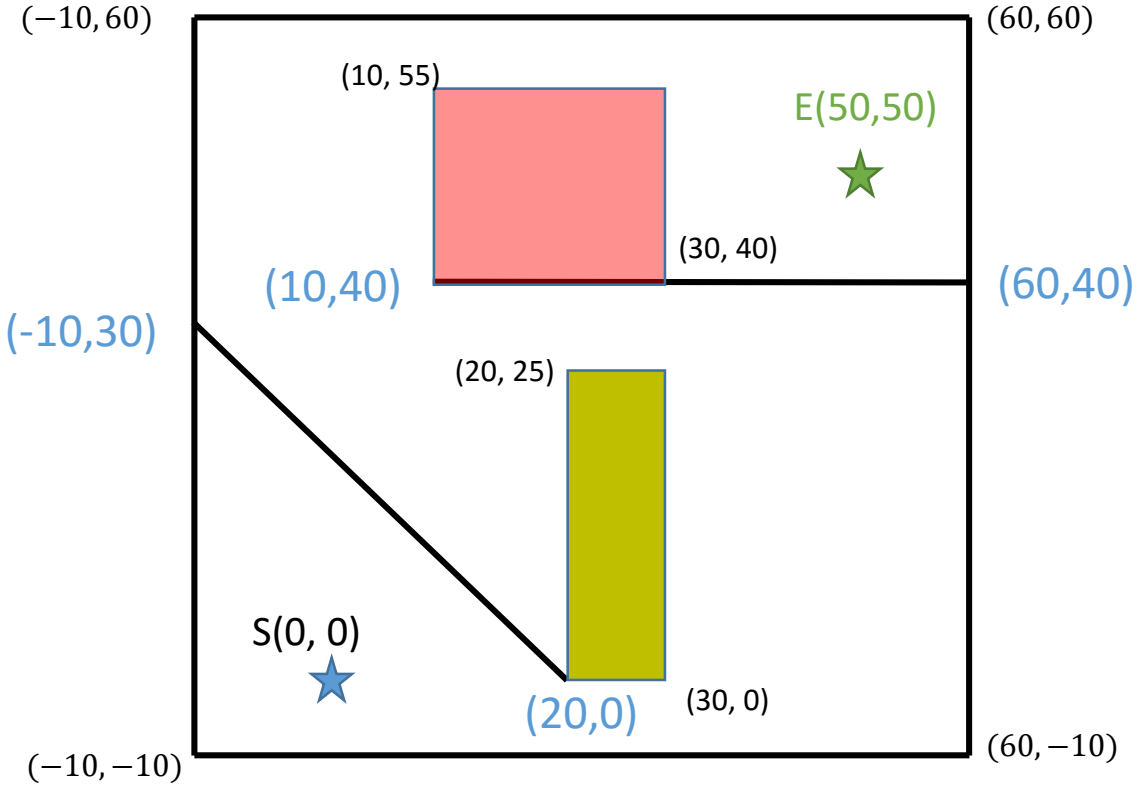
Start node

Goal node

Fuel-consuming area

Time-consuming area

Group 4



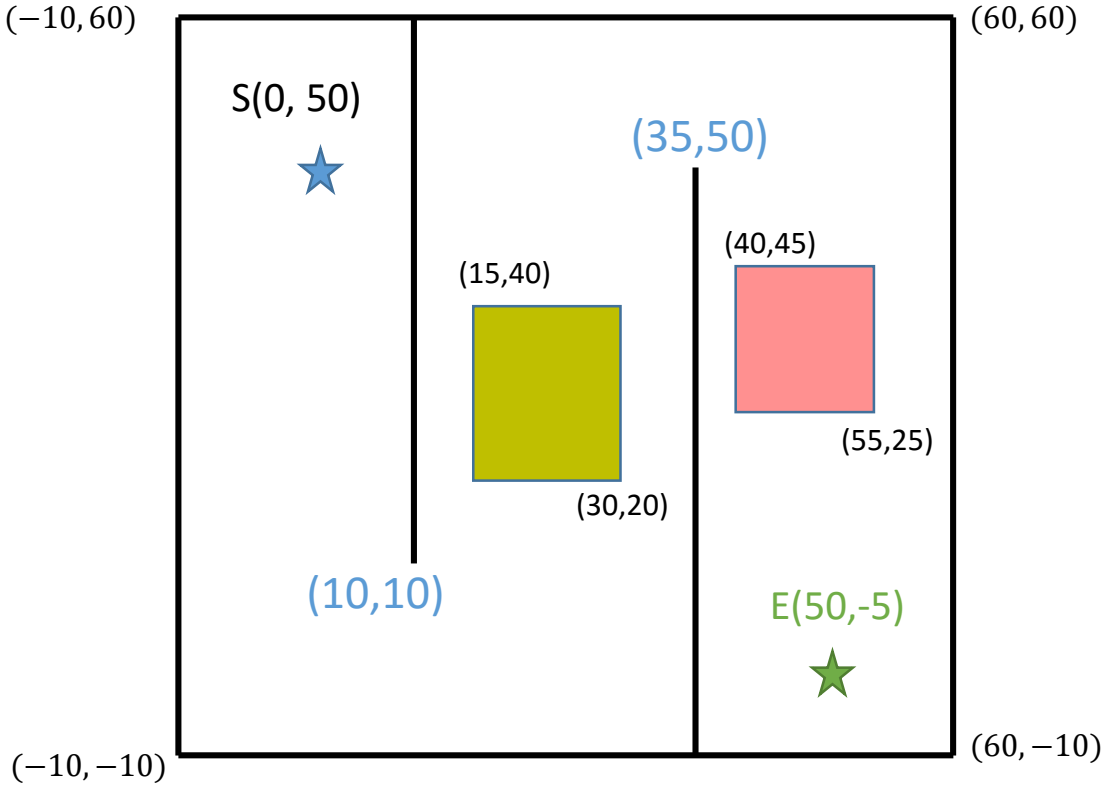
Start node

Goal node

Fuel-consuming area

Time-consuming area

Group 5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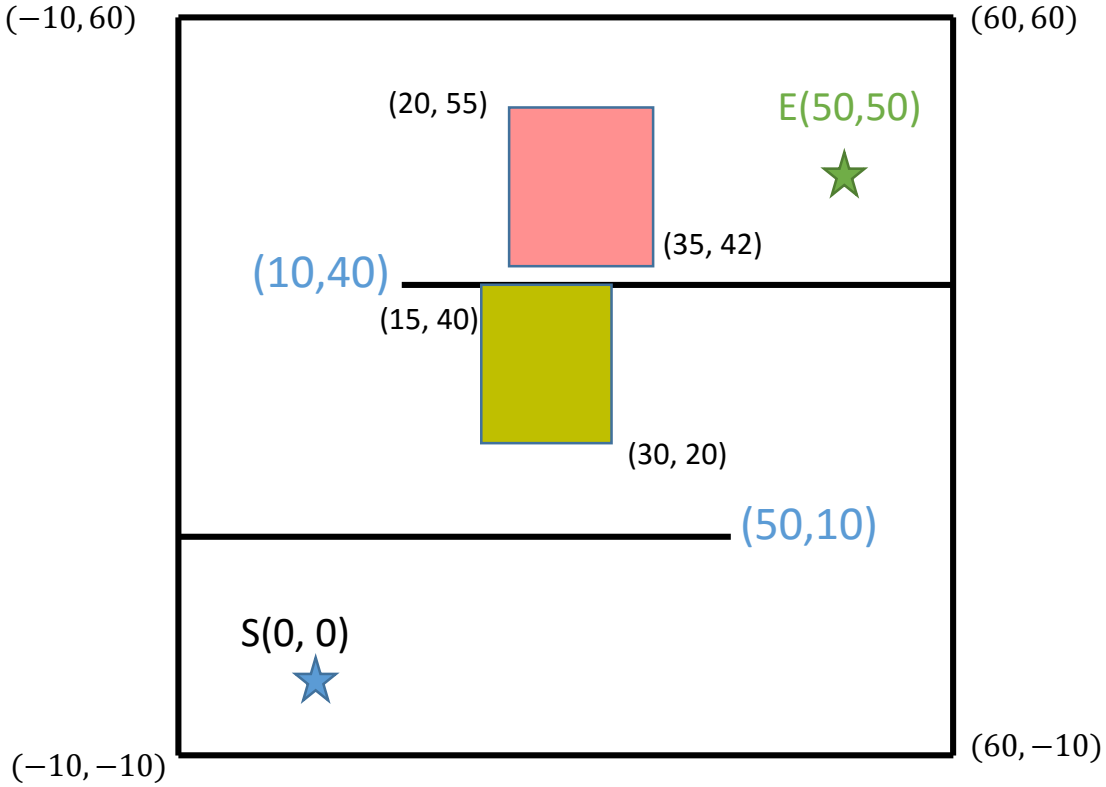
(60, 60)
S(0, 50)
(35,50)
(40,45)
(15,40)
(55,25)
(30,20)
(10,10)
E(50,-5)
(−10, −10)
(60, −10)
Start node
Goal node
Fuel-consuming area
Time-consuming area

Group 6



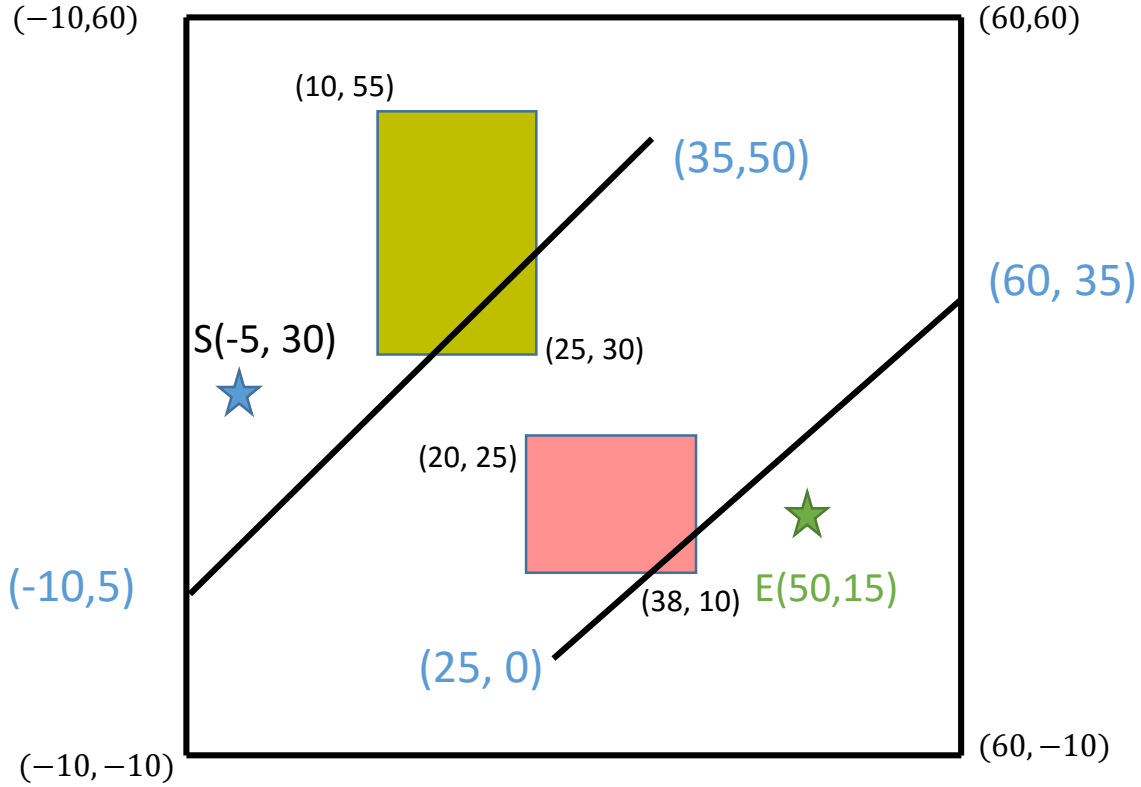
Start node

Goal node

Fuel-consuming area

Time-consuming area

Group 7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(60, 35)
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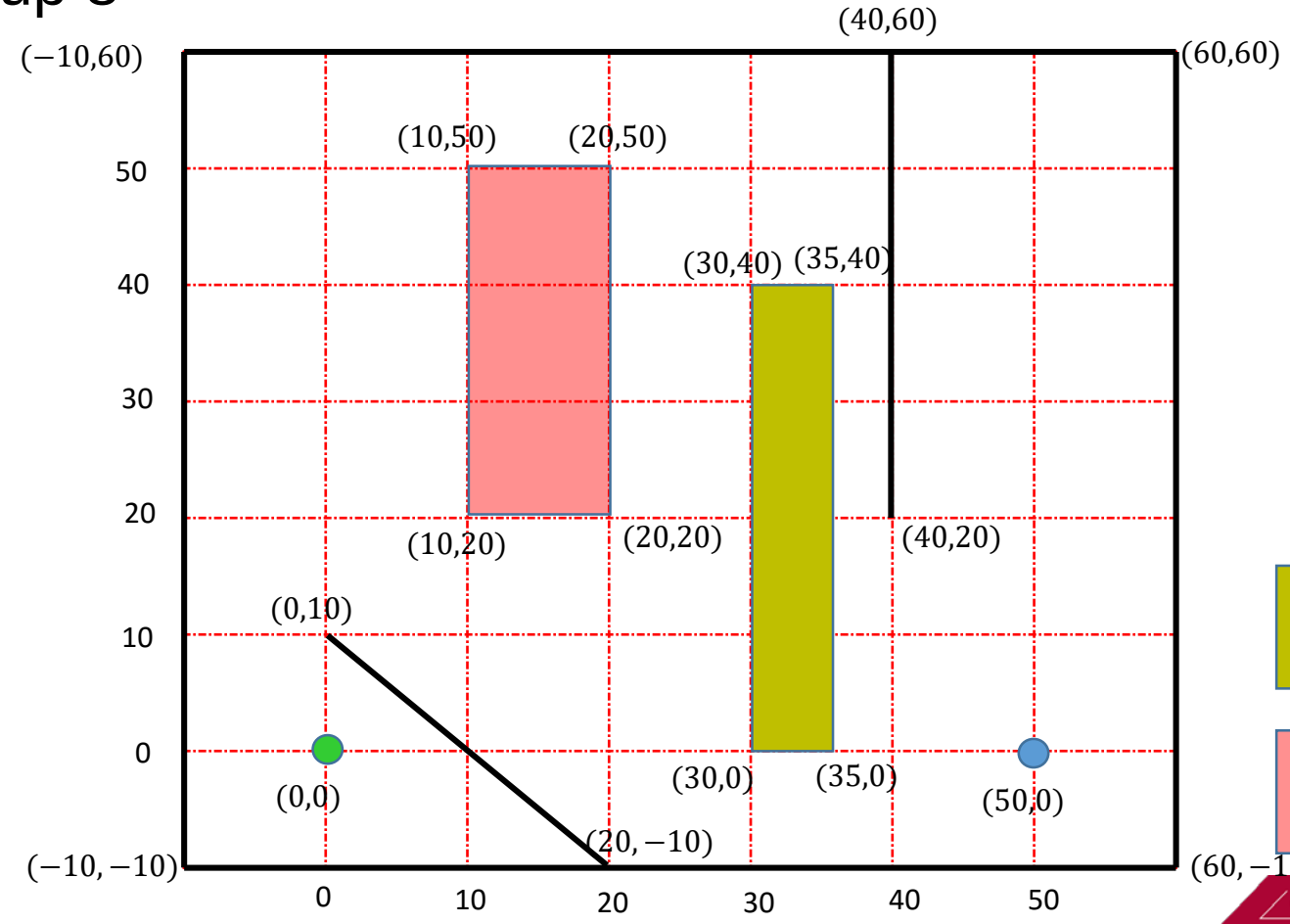
(25, 30)
(20, 25)
(-10,5)
(38, 10)
E(50,15)
(25, 0)
(−10, −10)
(60, −10)
Start node
Goal node
Fuel-consuming area
Time-consuming area

Group 8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(35,40)
40
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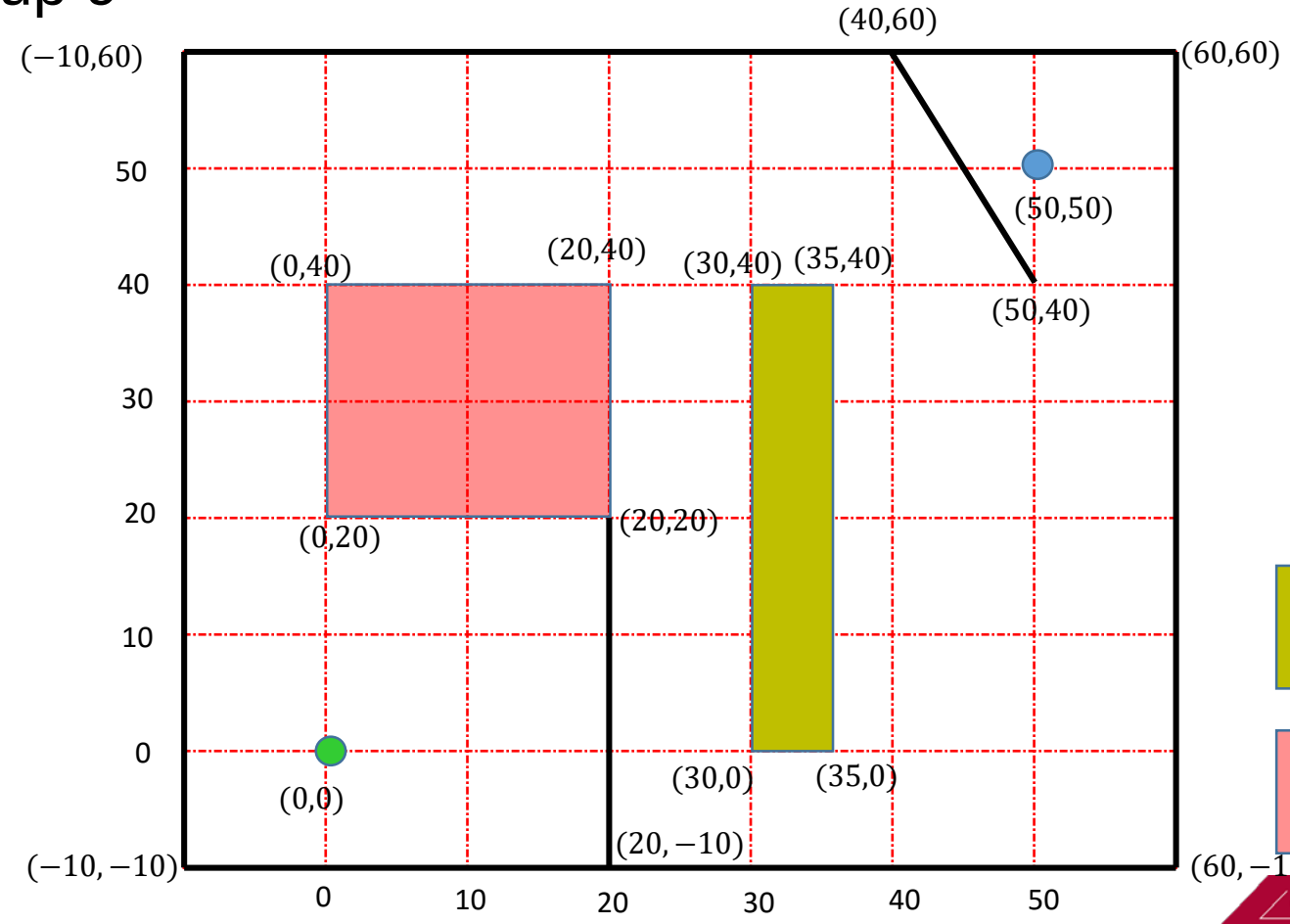
(10,20)
(20,20)
(40,20)
(0,10)
10
0
(0,0)
(30,0)
(35,0)
(50,0)
(20, −10)
(−10, −10)
(60, −10)
0
10
20
30
40
50
Start node
Goal node
Fuel-consuming area
Time-consuming area

Group 9



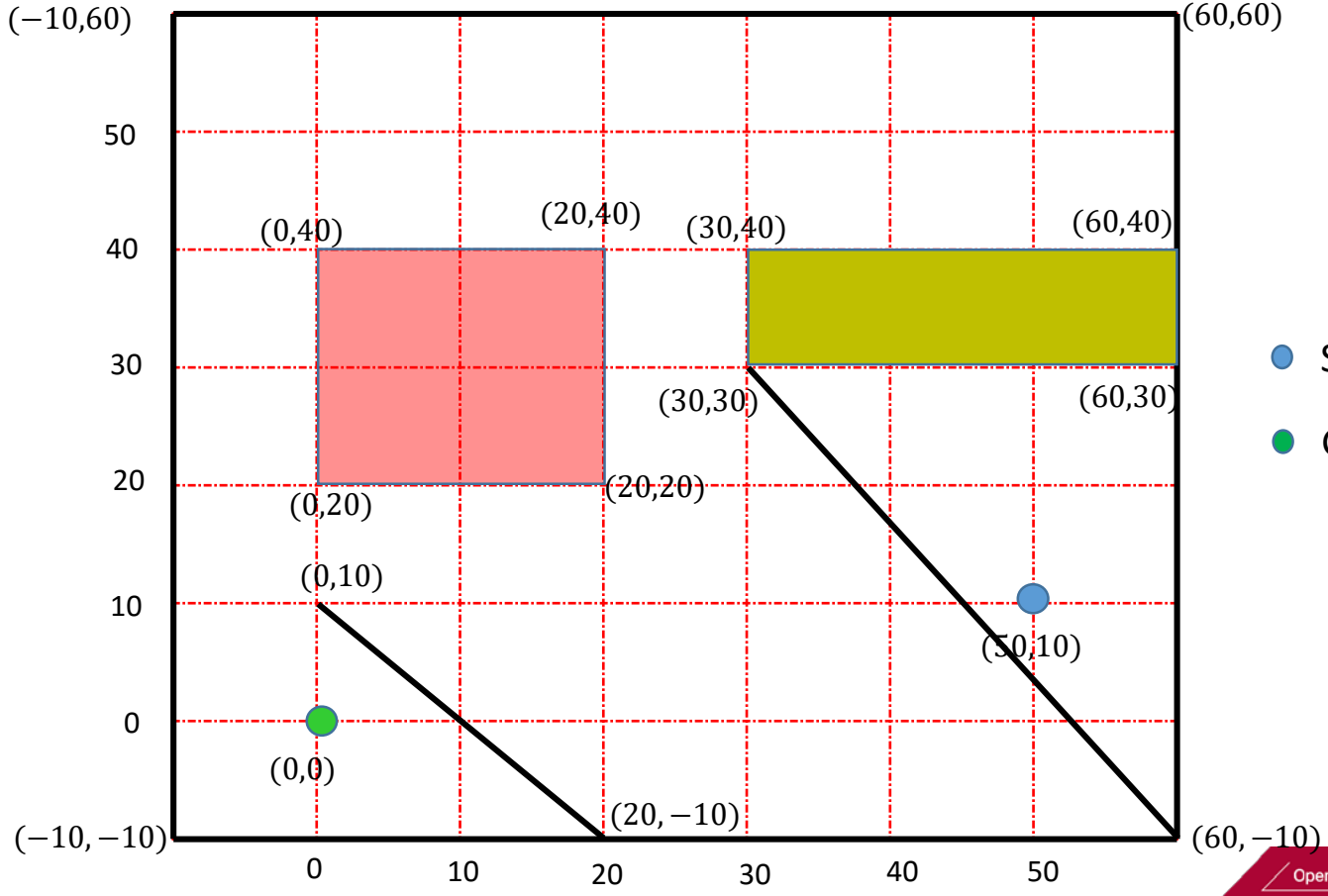
Start node

Goal node

Fuel-consuming area

Time-consuming area

Group 10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40
30
20
10
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(0,40)
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(30,30)
(60,30)
(0,20)
(20,20)
(0,10)
(50,10)
(0,0)
(20, −10)
(−10, −10)
(60, −10)
0
10
20
30
40
50
Start node
Goal node

Find the PolyU Aircraft Model that achieve minimum cost for the challenge assigned to your group.

Task 2

The PolyU Aircraft Models (4 constraints with 2 variables)

Brand your own model name based on your features.

Aircraft Model	C_F	ΔF	C_T	ΔT	C_c	ΔF_a	ΔT_a
~~PolyU-A380~~	~~1~~	~~1~~	~~2~~	~~5~~	~~10~~	~~0.2~~	~~0.2~~
Group 1 Aircraft Model (cool name)_	?	5	?	5	10	5	5
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Group 10 Aircraft Model (cool name)_	?	5	?	5	10	5	5

$$C = C_F \cdot \Delta F + C_T \cdot \Delta T + C_c$$

Constraints (C_F>0 and C_T>0)

$$C_T - C_F \leq 30$$
$$-0.5C_T - C_F \leq -30$$
$$2C_T - C_F \geq 20$$
$$-4C_T - C_F \geq -220$$

With

- C_F=cost of fuel per kg
- C_T=time related cost per minute of flight
- C_c=fixed cost independent of time
- C_T=time related cost per minute of flight
- ΔF=trip fuel
- ΔT=trip time

The PolyU Aircraft Models (4 constraints with 6 variables)

Brand your own model name based on your features.

Aircraft Model	C_F	ΔF	C_T	ΔT	C_c	ΔF_a	ΔT_a
~~PolyU-A380~~	~~1~~	~~1~~	~~2~~	~~5~~	~~10~~	~~0.2~~	~~0.2~~
Group 1 Aircraft Model (cool name)_	?	?	?	?	10	?	?
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
Group 10 Aircraft Model (cool name)_	?	?	?	?	10	?	?

$$C = C_F \cdot \Delta F + C_T \cdot \Delta T + C_c$$

Constraints (all variables >0, integer)

$$C_F \Delta F + C_T \Delta T \geq 25$$
$$C_F + C_T \geq 10$$
$$\Delta F + \Delta T \geq 10$$
$$\Delta F_a + \Delta T_a \geq 10$$

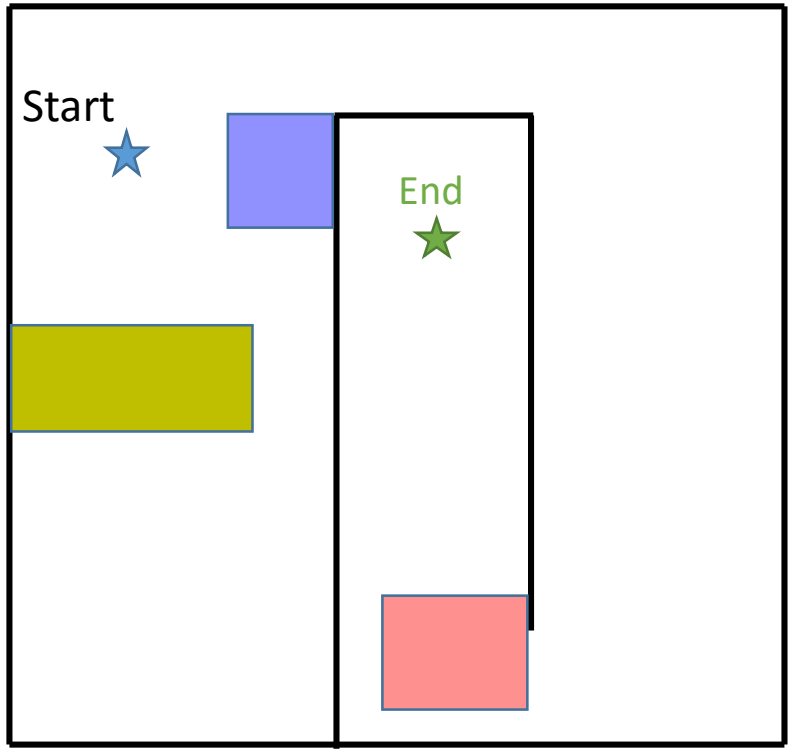
With

- C_F=cost of fuel per kg
- C_T=time related cost per minute of flight
- C_c=fixed cost independent of time
- C_T=time related cost per minute of flight
- ΔF=trip fuel
- ΔT=trip time

Design a new cost area that can reduce the cost of the route.

Task 3

Additional minus cost area (you decide the location)



- Use the PolyU A380 Aircraft Model
- Find the best minus-cost-area in your group challenge.
- The maximum size of (minus-cost-area) is 16m^2 (16 grid points)

Aircraft Model	C_F	ΔF	C_T	ΔT	C_c	ΔF_a	ΔT_a	C_P	ΔP
PolyU-A380	1	1	2	5	10	0.2	0.2	-2	2

$$C = C_F \cdot \Delta F + C_T \cdot \Delta T + C_c + C_P \cdot \Delta P$$