Instructions

- You have 2 hours and 30 minutes to complete the first part of the competition. This booklet will be collected at 12:45 P.M.

- For each question, there is space in this booklet for writing your answer. For final submission, you must enter all your solutions in the excel file.

- Please note that your solution will be marked based on the following criteria:
  - Feasibility of your solutions (i.e. whether or not your solution satisfies all requirements given in the questions)
  - The objective value of your solution
  - Your solution will be penalized if it violates any requirements given in the questions (feasible solutions will always receive better scores than infeasible solutions)

- For any question, please consult with TORCH mentors.

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1 The Streets of Downtown Montreal

Part 1 - Surveillance System

The Montreal Police Department has approved a new surveillance project to install cameras on the streets of downtown Montreal to help officers and detectives in their work. You have been hired by the Department to help optimize the design of the new system. You will be in charge of specifying the number of cameras to be used and the location of each camera. The Police Department has provided you with the following instructions:

1. The cameras can only be located on street intersections.
2. A camera placed on a certain intersection will be able to monitor all streets connected to the intersection.
3. The objective of the system is to monitor all the streets meaning that each street must be monitored by at least one camera.
4. Cameras are sold in bundles of 2, 3, and 5 with costs of $1100, $1500 and $2300, respectively. The Department would like to minimize the cost of their new surveillance program to achieve the aforementioned objective.

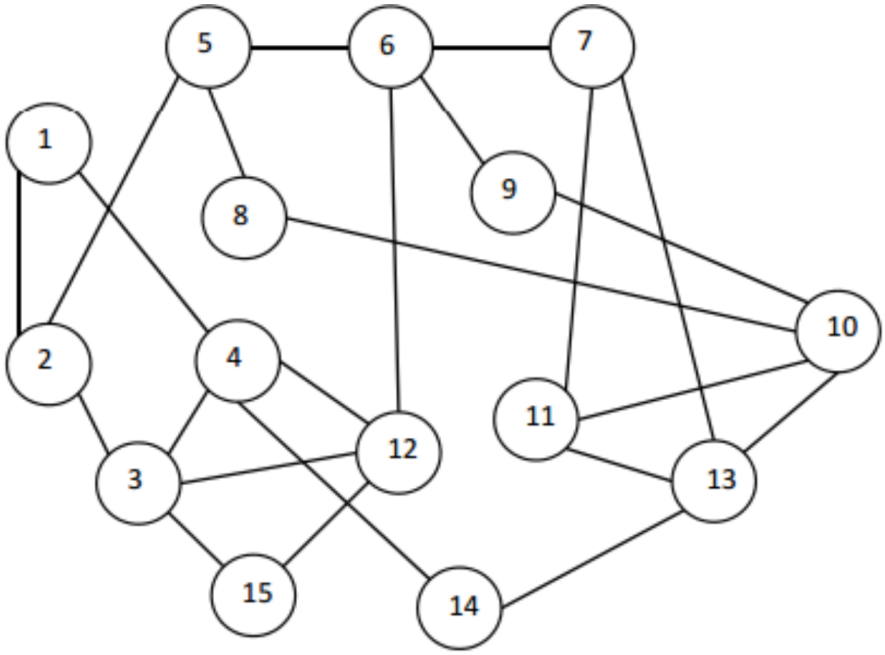

Figure 1: Map of downtown Montreal

The Montreal Police Department also provided you with the abstract network which represents the map of downtown Montreal (see Figure 1). The nodes (circles) in this network represent the street intersections, and the edges (links) represent the streets.

The performance of your proposed plan will be measured according to your ability to cover all the streets with the surveillance system as well as the cost of the plan.

Answer

How many surveillance cameras do you plan to install? _____

Where should the surveillance cameras be installed?

_____

Specify the number of bundles of each type you want to purchase:

Bundle of 2 cameras: _____,

Bundle of 3 cameras: _____,

Bundle of 5 cameras: _____.

Part 2 - Campaign Planning

The campaign office of a prominent candidate for the Montreal municipal elections is planning an event in the streets of downtown Montreal. The campaign office hired you to optimize the campaigning efforts.

The office is planning to campaign on the intersections of streets by setting up large P.A. systems through which publicity will be announced. To avoid being fined for noise pollution, the campaign office has strictly specified that **no two systems are to be located at endpoints of the same street (link in the network of Figure 2).**

The campaign office provided you with the abstract network which represents the map of downtown Montreal (see Figure 2). The nodes (circles) in this network represent the street intersections, and the edges (links) represent the streets. Your job is to propose where to locate the P.A. systems so that the maximum number of streets are covered but **no street is incident to more than one P.A. system**. The mayoral candidate has proposed a solution that covers 16 streets, try to find a better solution.

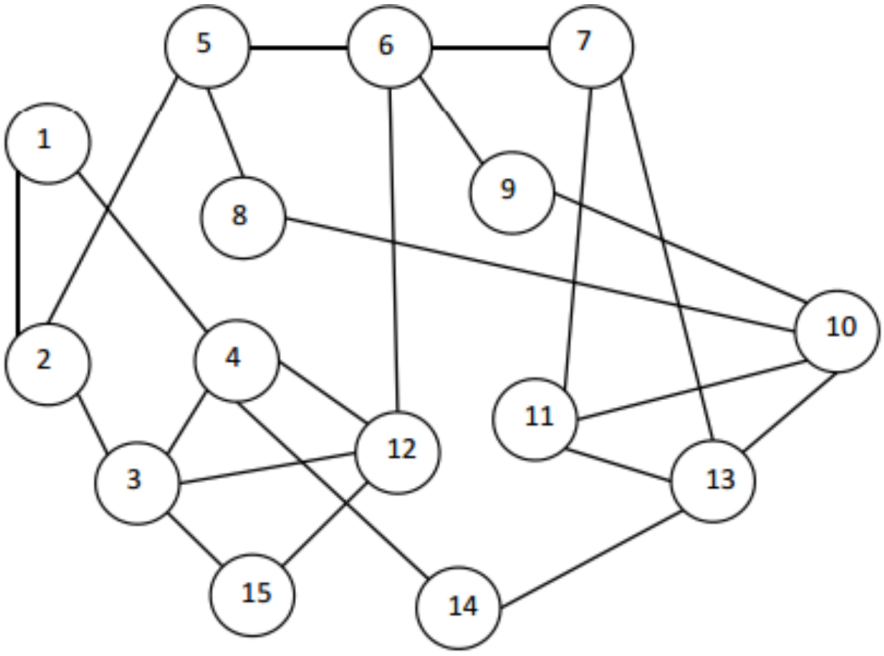

Figure 2: Map of downtown Montreal

Answer

How many streets did you manage to cover? _____

Where do you plan to locate the P.A. systems? _____

2 Sports Scheduling for the Canadian Football League

The Canadian Foot league (CFL) is a professional sports league in Canada. The CFL has nine teams, which are located in nine separate cities. These nine teams are divided into East and West divisions. Table 1 and Figure 3 provide information regarding the division and location of each of the nine teams.

Team Name	Abbrev.	Location
East Division		
HAMILTON TIGER-CATS	**HAM**	Hamilton, ON
MONTREAL ALOUETTES	**MTL**	Montreal, QC
OTTAWA REDBLACKS	**OTT**	Ottawa, QC
TORONTO ARGONAUTS	**TOR**	Toronto, ON
West Division		
BC LIONS	**BC**	Vancouver, BC
CALGARY STAMPEDERS	**CGY**	Calgary, AB
EDMONTON ESKIMOS	**EDM**	Edmonton, AB
SASKATCHEWAN ROUGHRIDERS	**SSK**	Regina, SK
WINNIPEG BLUE	**WPG**	Winnipeg, MB

Table 1: List of teams in the Canadian Football League

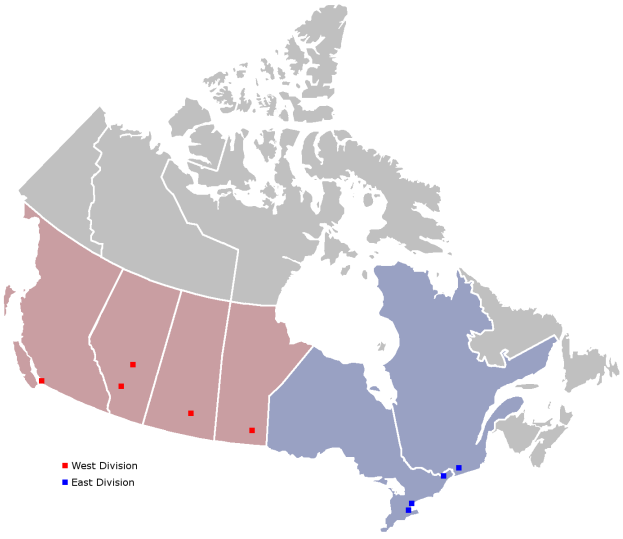

Figure 3: Location of Nine CFL teams.

Part 1 - CFL regular season schedule

The Canadian Football League features a regular season where each team plays with every other team exactly once, either a *HOME* game or an *AWAY* game (e.g. Toronto plays against Montreal at Toronto's home court, the game is considered as a *HOME* game for Toronto and an *AWAY* game for Montreal). The team that is not scheduled to play is said to take a *BREAK*. Such a sports scheduling problem is commonly referred to as a **Single Round Robin**.

Question

You are hired by the CFL to create a **Single Round Robin schedule** for the regular season of next year. Your schedule must satisfy the following conditions:

1. All nine teams in CFL must be included in the final schedule
2. The total time window for scheduling all games is 9 weeks, each team must play with every other team exactly once.
3. Each team must play exactly 8 games throughout 9 weeks, with exactly one *BREAKS*, at least 2 *HOME* games, and 2 *AWAY* games
4. Each week, you must schedule 4 games with 8 teams, and let one team take a *BREAK*
5. A team cannot play more than two consecutive *HOME* or *AWAY* games For example, if TOR is scheduled to play at Montreal (*AWAY*) in week 1 and play at Vancouver (*AWAY*) in week 2, then TOR must either play at home court (i.e. *HOME* game) or take a *BREAK* in week 3.
6. CGY and OTT played the final Championship match in 2016 (which is also called, the 104th Grey Cup). The match between these two teams is expected to be very popular, thus these two teams must play against each other in week 1.
7. It is a tradition in the CFL to schedule "rival" pairing games during the final week (which is week 9). There are four well- known "rival" pairings in the CFL:

   EDM-CGY, WPG-SSK, TOR-HAM, MTL-OTT.

   At least two of these "rival" pairings must be scheduled to play in week 9.

Answer

Please use the following table to create your schedule for the CFL regular season.

Note: Instructions and hints on how to construct the scheduling table as well as how to use the answer sheet are given on the next page, please read them carefully before starting to answer the question.

Week	1		2		3		4		5		6		7		8		9	
Game Info.	H/A/B	Oppo.	H/A/B	Oppo.	H/A/B	Oppo.	H/A/B	Oppo.	H/A/B	Oppo.	H/A/B	Oppo.	H/A/B	Oppo.	H/A/B	Oppo.	H/A/B	Oppo.
HAM																		
MTL																		
OTT																		
TOR																		
BC																		
CGY																		
EDM																		
SSK																		
WPG																		

Table 2: Answer Sheet for CFL question part 1

Instructions

1. General guidelines to effectively construct a Single Round Sports Schedule:
   (a) Try to generate the HOME/AWAY/BREAK schedule first, make sure that you have exactly one BREAK in each week
   (b) Next, fix the schedule for games that are specified in the question (i.e. conditions 6 and 7). After that, complete the rest of the schedule for each week
   (c) Check if your schedule satisfies other required conditions (if not, make the necessary modifications)

2. To use the answer sheet, enter the following information in each cell:
   Game type (H/A/B): Please enter **H** for *HOME* Game, **A** for *AWAY* Game or **B** for *BREAK*,
   Opponent: Please enter the opponent's team abbreviation. For the team scheduled to have a *BREAK*, please leave the opponent's cell empty.

   Here is an example schedule of 5 teams during week 1:
   (a) Toronto plays at Home against Hamilton which means Toronto plays a *HOME* game, and Hamilton plays an *AWAY* game
   (b) Montreal plays at Home against Ottawa which means Montreal plays a *HOME* game, and Ottawa plays an *AWAY* game
   (c) BC does not play which means BC has a *BREAK* in week 1
   Consequently, the information should be entered in the *ANSWER SHEET* as follows:

	Week 1	
	H/A/B	Opponent
TOR	H	HAM
HAM	A	TOR
MTT	H	OTT
OTT	A	MTL
BC	B	

3. There might exist more than one correct solution.
   This question will be graded based on whether or not your solution satisfies all the required conditions. You will be penalized if your solution fails to meet the required conditions.

Part 2 - Improve the schedule by minimizing the traveling distance

In part 1, you just successfully generated a complete **Single Round Robin** schedule for the next CFL regular season. You might have noticed that there exists different schedules which satisfy all requirements. To evaluate whether a schedule is "good" or "bad", we need to introduce some measurement tools. There exists many different measurement tools to evaluate the quality of a sports schedule. One popular and practical one is the traveling distance.

Question

Please construct a new three-week schedule for the CFL games. Similar to part 1, your solution must satisfy all the requirements given below. In addition to that, try to modify your schedule in such a way that the average traveling distance is minimized.
∗ *Requirements in part 1 are not applicable here.*

1. Include all nine teams in your schedule.
   Each week, a team can play a *HOME* game, an *AWAY* game or take a *BREAK*.
2. Each team must play at least one *HOME* game in these three weeks.
3. No team can have more than one *BREAK* in these three weeks.
4. Each team can play with another team only once.
   e.g. if you schedule TOR-MTL in week 1, then these two teams cannot play with each other in other weeks.
5. Each team must play against a team from a different division.
   e.g. TOR belongs to East Division, the team must play at least one game against a team from the West Division. The game could be either a *HOME* or an *AWAY* game.
6. Every week, you must schedule exactly four games and let a team have a *BREAK*. Thus, you should schedule 12 games in total during these three weeks.
7. The traveling distance between the different cities are given as follows (table 3):

Distance (km)	**HAM**	**MTL**	**OTT**	**TOR**	**BC**	**CGY**	**EDM**	**SSK**	**WPG**
HAM	0	608	477	68	4318	3349	3410	2630	2170
MTL	608	0	198	542	4914	3604	3580	2847	2266
OTT	477	198	0	411	4364	3341	3455	2614	2142
TOR	68	542	411	0	4386	3419	3478	2698	2238
BC	4318	4914	4364	4386	0	972	1160	1743	2314
CGY	3349	3604	3341	3419	972	0	299	758	1329
EDM	3410	3580	3455	3478	1160	299	0	782	1305
SSK	2630	2847	2614	2698	1743	758	782	0	573
WPG	2170	2266	2142	2238	2314	1329	1305	573	0

Table 3: Traveling distances between the different cities

Answer

Please use the following table to create your schedule for the CFL regular season.

Note: Instructions on how to calculate the average traveling distance as well as how to use the answer sheet are given on the next page, please read them carefully before starting to answer the question.

Week	1		2		2		Traveling Distance		
Game Info.	H/A/B	Opponent	H/A/B	Opponent	H/A/B	Opponent	week 1 to Week 2	Week 2 to Week 3	Total
HAM									
MTL									
OTT									
TOR									
BC									
CGY									
EDM									
SSK									
WPG									
What is the average traveling distance per game?							_____km		

Table 4: Answer sheet for CFL questions part 2

Instructions

Carefully read the following instructions on how to calculate the traveling distances.

1. To use the answer sheet, enter the following information in each cell:
   Game type (H/A/B): Please enter **H** for a *HOME* game, **A** for an *AWAY* game, or **B** for a *BREAK*
   Opponent: Please enter the opponent's team abbreviation
   For the team scheduled to have a BREAK, please leave the opponent's cell empty.

   Please use the following equation to calculate the average traveling distance:

   $$\text{Average Traveling Distance} = \frac{\text{total traveling distance of all teams in 3 weeks}}{\text{total number of games in 3 weeks}}$$

2. Don't consider the traveling distance in week 1 no matter if a team starts week 1 with a HOME or an AWAY game. This means, you only need to consider the traveling of each team from week 1 to week 2, and then from week 2 to week 3.

3. At a given time slot, a team is considered to be located in the city where its game is scheduled to take place. i.e. TOR (H) – MTL(A), both teams of Toronto and Montreal are considered to be located in the city of Toronto during the time slot of this game.

4. Moving to the next time slot, a team must travel the necessary distance to play the game in the city where it is scheduled.

Week	1		2		Distance from week 1 to week 2
Game Info.	H/A/B	Oppo.	H/A/B	Oppo.	
HAM	H	MTL	A	TOR	68 km (**HAM** travels from *Hamilton* to *Toronto*)
MTL	A	HAM	A	CGY	3349 km (**MTL** travels from *Hamilton* to *Calgary*)

5. If a team is scheduled to play two consecutive games in the same city then its traveling distance between these two time slots is considered to be zero.

Week	1		2		Distance from week 1 to week 2
Game Info.	H/A/B	Oppo.	H/A/B	Oppo.	
HAM	H	MTL	H	TOR	0 km

6. If a team is scheduled to have a BREAK following either a HOME or an AWAY game, the team is considered to be located in the same city without moving. Therefore, the traveling distance between these two time slots is considered to be zero.

Week	1		2		Distance from week 1 to week 2
Game Info.	H/A/B	Oppo.	H/A/B	Oppo.	
HAM	H	MTL	B		0 km

7. If a team starts with a BREAK in week 1, then this team is considered to be located in its home city

Week	1		2		Distance from week 1 to week 2
Game Info.	H/A/B	Oppo.	H/A/B	Oppo.	
HAM	B		A	TOR	608 km **HAM** is located in *Hamilton* during week 1. It travels from *Hamilton* to *Montreal*
MTL	B		H	CGY	0 km **MTL** is located in *Montreal* during week 1. It doesn't have to travel from week 1 to week 2.)

8. Please note that, this question will be marked based on two criteria:
   (a) A feasible solution satisfies all the requirements that are stated in the question. You will get penalized for not meeting the requirements.
   (b) The value of the average traveling distance per game

3 The Martian Settlement

In year 2045, the Higher Terrestrial Council approved a proposition submitted by the Independent Martian Explorers (IME) to build a settlement on Mars. The council believes it's a spark of hope for humankind to start again, to build an extraterrestrial civilization based on egalitarian values, sustainability, diversity, and inclusion. The settlement will also enable Earthlings to engage in deep space exploration and conduct research on human adaptability to the conditions on other planets.

Part 1 - The Martian Explorers

During the first stage, the IME proceeds to choose skilled crew members among the program trainees. By the end of the training program, all candidates have passed the four pre-selection rounds. Each of them has a record of scores in various fields and disciplines assessing how efficient he/she would be holding a particular position during the journey to Mars. After their arriving the on Mars, each member will contribute in building and developing one of the first four main units that compose the settlement: the power plant (U1), the food bank (U2), the water supply (U3), and the research and development unit (U4). In addition there will be a special unit (U5) that includes medical aid, psychological support, and ICT supervision of the settlement.

Question

Help the IME carefully choose the crew composed of 12 astronauts. Your choice should be made in such a way to have the most competent candidates hold the available positions during the journey and the construction of the settlement. Your solution must satisfy the following conditions:

1. You must select exactly 12 astronauts out of the 25 candidates
2. During the journey from Earth to Mars, there are 7 different crew positions (specified as C1-C7 in Table 5).
   (a) You must assign exactly one astronaut to each crew position. As a result, the rest of 5 astronauts are passengers who do not hold a crew position.
   (b) Scores in Table 7 represent candidates' ability to hold a crew position (i.e. the higher the score, the better).
3. After their arrival on the Mars, the team will start establishing the foundation of the settlements. There are four main units (U1, U2, U3 and U4), and one special units (U5).
   (a) For units U1-U4, there are 3 different positions for each unit (specified as P1-P12 in Table 6), and you must assign exactly one astronaut to each position. As a result, everyone must hold a position in units U1-U4.

(b) Scores in Table 8 represent candidates' ability to hold a position in units U1-U4 (i.e. the higher the score, the better).

(c) For unit U5, there are 3 different positions (specified as P13-P15 in Table 6), you need to assign exactly one astronaut to each position. As a result, 3 astronauts will hold 2 positions (1 position in units U1-U4, and one position in unit U5), and the rest of the 9 astronauts will only hold only 1 position in units U1-U4.

(d) Only candidates listed as below can take positions in unit U5.

i. Candidates 14, 21, and 25 have a degree in the medical sciences (D13)

ii. Candidates 15 and 22 have a degree in psychology (D14)

iii. Candidates 2, 4, 8, and 12 have a degree in ICT systems (D15)

iv. There is no score related to positions in unit U5

4. In addition, your solution must satisfy following conditions:

(a) The crew commander cannot be part of the special unit (see condition 2)

(b) Candidates 14 and 22, 15 and 21, as well as candidates 2 and 24 cannot work in the same unit on Mars (i.e. in units U1-U5) due to conflict

Code	Position
C1	Commander
C2	Pilot
C3	Spaceflight engineer
C4	Martian module pilot
C5	Docking module pilot
C6	Payload specialist
C7	Science officer

Table 5: The different positions on spaceship to hold during the journey to Mars

Code	Unit	Position requirement of each unit	
		Code	Discipline
U1	Powerplant	D1	Power engineering
		D2	Renewable energy engineering
		D3	Energy storage systems
U2	Cuisine	D4	Astrobotany
		D5	Agricultural engineering and holticulture
		D6	Agrochemistry
U3	Fountain	D7	Hydraulics
		D8	Hydrogeology
		D9	Hydrochemistry
U4	The Lab	D10	Astrobiology
		D11	Cosmology and planetary science
		D12	Astrophysics and astrochemistry
U5	Special unit	D13	Medical sciences
		D14	Psychology
		D15	ICT systems

Table 6: Units of the Martian settlement and the required competences to be run

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
Candidate 1	20	5	4	10	14	3	3
Candidate 2	13	14	11	13	12	12	14
Candidate 3	10	3	10	13	1	12	12
Candidate 4	11	10	7	5	4	13	1
Candidate 5	3	9	9	9	15	13	1
Candidate 6	2	6	5	6	3	1	3
Candidate 7	14	9	10	15	5	15	2
Candidate 8	11	12	2	1	3	5	15
Candidate 9	2	5	15	4	12	4	10
Candidate 10	5	7	15	5	12	14	14
Candidate 11	15	15	4	5	14	14	15
Candidate 12	15	6	12	2	9	4	12
Candidate 13	15	14	13	11	9	5	6
Candidate 14	5	10	13	5	9	3	4
Candidate 15	12	15	1	1	4	12	12
Candidate 16	1	11	14	3	10	14	8
Candidate 17	13	5	9	8	5	4	13
Candidate 18	1	8	4	13	13	12	2
Candidate 19	13	14	12	8	15	14	12
Candidate 20	1	9	10	13	12	3	7
Candidate 21	5	6	11	12	4	3	9
Candidate 22	12	2	3	5	9	5	7
Candidate 23	2	15	2	1	12	3	15
Candidate 24	9	1	4	8	8	15	3
Candidate 25	15	12	8	1	2	3	6

Table 7: Scores obtained by the candidates in various fields assessing how efficient they would be holding a particular position

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**
Candidate 1	17	7	1	12	6	2	1	3	8	11	9	7
Candidate 2	1	1	14	12	15	8	8	5	10	11	9	8
Candidate 3	6	13	4	12	9	1	12	14	7	1	3	3
Candidate 4	10	10	7	13	3	2	10	4	13	5	15	8
Candidate 5	14	3	1	11	14	15	6	10	5	5	12	12
Candidate 6	9	10	1	9	3	2	7	6	14	13	2	7
Candidate 7	3	7	1	4	11	12	10	6	2	14	8	12
Candidate 8	1	11	8	6	10	14	14	3	1	7	12	4
Candidate 9	5	1	11	5	8	14	5	1	15	9	10	11
Candidate 10	13	14	14	6	11	7	10	3	13	11	1	13
Candidate 11	3	3	13	9	5	12	7	8	13	7	14	2
Candidate 12	13	6	1	9	3	15	3	7	3	11	1	15
Candidate 13	15	12	7	14	5	7	9	11	10	14	5	4
Candidate 14	9	14	1	9	2	14	3	13	9	10	8	10
Candidate 15	10	11	6	10	10	12	11	2	3	3	6	5
Candidate 16	2	13	12	2	9	3	1	6	3	14	3	1
Candidate 17	3	13	11	15	9	3	3	14	6	3	11	1
Candidate 18	8	6	13	2	15	5	10	7	1	12	2	10
Candidate 19	13	15	10	13	11	4	6	5	12	15	4	1
Candidate 20	3	9	12	9	9	2	4	14	4	4	11	14
Candidate 21	1	14	1	4	12	7	14	9	10	15	1	12
Candidate 22	7	9	9	13	3	13	4	8	11	15	4	7
Candidate 23	15	9	4	4	8	2	11	14	12	9	4	10
Candidate 24	6	2	9	4	14	14	12	11	11	11	5	1
Candidate 25	10	5	13	2	3	1	12	7	13	12	9	10

Table 8: Scores obtained by the candidates in scientific disciplines assessing how efficient they would be working in a particular unit within the Mars settlement

Answer

1. Fill in the table below showing the candidates you want to selected to be part of the crew and which positions they should be assigned to.
2. If a chosen candidate holds no position during the journey or isn't part of unit 5 then keep the allocated cell(s) empty. Your solution will be penalized if you violate the aforementioned conditions.

	Candidate number	Position	Units	
			U1-4	U5
Astronaut 1				
Astronaut 2				
Astronaut 3				
Astronaut 4				
Astronaut 5				
Astronaut 6				
Astronaut 7				
Astronaut 8				
Astronaut 9				
Astronaut 10				
Astronaut 11				
Astronaut 12				

Table 9: Assignment of astronauts

Part 2 - Rise of the Martian civilization

The next challenge the Martian explorers face is the rapid depletion of their reserve of Oxygen (O_2) brought from Earth. As terrestrial newcomers will be arriving in ten years to help build a Martian civilization, the crew needs to think of ways to make breathing a second nature on Mars just like on their home planet. One widely accepted option by scientists is to plant special kinds of trees to absorb the carbon dioxide emissions of the settlement and produce O_2. This way, in ten years, the settlement becomes sustainable in oxygen supplies. The crew already brought seeds of these trees and their plan is to start planting them after having succeeded at establishing the foundations of the settlement. Their next mission is a crucial step in the rise of the Martian civilization and its survival.

Important Information

1. There are five types of trees. TR1, TR2, ..., and TR5 (see Figure 4). Each tree needs a specific time to grow. While a tree grows it can produce O2, but it requires water and space.

Figure 4: Five different types of trees

2. Table 10 shows the O_2 emission rate (per pound) by the different trees in ten years. For example, TR4 can produce 612 pounds of O_2 in ten years.

	TR1	**TR2**	**TR3**	**TR4**	**TR5**
Total O_2 production over 10 years	495	640	275	612	865

Table 10: O_2 production rate (per pound) by tree

3. All kind of trees consume water. Table 11 you can see the yearly water that a tree needs in gallons. The rate changes and increases while it is growing.

Year	1	2	3	4	5	6	7	8	9	10
TR1	40,000	70,000	80,000	90,000	100,000	110,000	120,000	120,000	130,000	130,000
TR2	30,000	54,000	90,000	126,000	135,000	144,000	144,000	144,000	144,000	153,000
TR3	22,000	35,000	45,000	55,000	80,000	85,000	95,000	100,000	105,000	110,000
TR4	52,000	58,500	67,600	71,500	78,000	84,500	91,000	91,000	97,500	104,000
TR5	48,000	96,000	144,000	144,000	144,000	152,000	160,000	160,000	168,000	168,000

Table 11: Yearly water consumption per type of tree in gallons

4. On Mars there is no liquid water. As a result, the crew has to melt available chunks of ice and stock them in the water supply unit. These chunks of ice are scattered on the red planet which makes their positions heterogeneous. Therefore, the available amount of water is not the same for the whole period of ten years. Also, if the crew does not use the amount of water available during a given year, they cannot keep it and use it for the next year(s). Table 12 shows how much water is available for each year (in million gallons).

Year	1	2	3	4	5	6	7	8	9	10
Yearly available water (million gallons)	0.6	0.8	1	1.2	1.3	1.5	2	2.1	2	2.3

Table 12: Yearly available water in million gallons

5. Trees need space to grow. Table 13 depicts the required area (in m^2) for the growth of each kind of tree. The rate changes based on the age of a tree.

Year	1	2	3	4	5	6	7	8	9	10
TR1	2.2	3.8	4.3	4.8	5.4	5.9	6.5	6.5	7.1	7.2
TR2	2.1	2.2	3.1	3.2	3.3	3.3	3.9	4	4.5	5
TR3	2	2.1	2.2	2.3	2.4	2.5	2.6	2.7	3	4
TR4	2.7	3	3.5	3.7	4	4.3	4.7	4.7	5	5
TR5	2.5	5.1	7.6	7.6	7.6	8	8.5	8.5	8.9	9

Table 13: The required space for growth of each type in m^2

6. The crew needs to prepare more space for the planted trees. They have to make some arrangements on Mars for this purpose. The maximum amount of space they can provide each year is shown in Table 14. The rate is not the same and it is impossible to use the available space for one year during the other years.

Year	1	2	3	4	5	6	7	8	9	10
Yearly available space	28	32	42	45	50	60	65	70	75	80

Table 14: Yearly available space in m^2

Question

How many trees should the crew plant to produce the maximum amount of O_2 in the next ten years?

Answer

Your solution will be penalized if you exceed the available water and the available space limits in each year. It is not possible to dig out a tree when it is planted. The available water/space for each year can only be used on the same year and it is not possible to use it on the other years.

The number of planted trees from each type is:

Tree 1 _____, Tree 2 _____, Tree 3 _____,

Tree 4 _____, Tree 5 _____.

The total produced amount of O_2 for the next ten years will be _____.