Resource 1 - How many employees?

The problem

Norwest is a small chain of mini supermarkets serving small towns in the North West of England.

The manager of the head office has ten jobs which need to be completed this week.

Each employee works 30 hours per week.

The jobs can be done in any order by any employee.

Each job can only be done by one person.
Jobs can not be split or divided.

Job	Time required to complete the job (minutes)
A: Organise what is to be delivered to each store this week	16
B: Decide what store will get deliveries each day	12
C: Write down which goods are returned from each store	14
D: Check how much money each store has taken this week	10
E: Order new stock for next week	18
F: Check who is working in each store next week	8
G: Clean the offices	6
H: Write adverts on social media	12
I: Pay all the bills for the goods received last week	10
J: Organise the pay to make sure all workers get paid the correct amount	12

Task One

How many employees are required?

Robyn thinks 4 employees will be needed. This is because the total number of hours required is 118. If you divide 118 by 30 you get 3.93.

Explain whether you think Robyn is correct?

Can you think of a reason why the jobs may not be able to be completed by four people?

Task One

Solution

Total number of hours required to complete the jobs is 118.

118 is divided by 30 as each employee can work a maximum of 30 hours.

118 divided by 30 gives 3.93 indicating that, in theory, four employees are required to complete the jobs.

However, this relies on most employees working the full 30 hours.
As jobs cannot be split it may not be possible for employees to complete exactly 30 hours.

We need to allocate the jobs to employees to confirm how many are required.

Task Two: Schedule the employees

Using a first fit algorithm

Each employee can work for 30 hours.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Employee 1																															30 hours
Employee 2																															30 hours
Employee 3																															30 hours
Employee 4																															30 hours
Employee 5																															30 hours

Task Two

Using a first fit algorithm

Job A - 16 hours - can be completed by Alice leaving 14 hours.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																														14 hours
John																															30 hours
Ali																															30 hours
Jasmin																															30 hours
Robyn																															30 hours

Task Two

Using a first fit algorithm

Job B - 12 hours - can also be completed by Alice leaving 2 hours available.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John																															30 hours
Ali																															30 hours
Jasmin																															30 hours
Robyn																															30 hours

Task Two

Using a first fit algorithm

Job C - 14 hours - and **Job D** - 10 hours - cannot be completed by Alice but both jobs can be completed by John leaving 6 hours.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)																6 hours
Ali																															30 hours
Jasmin																															30 hours
Robyn																															30 hours

Task Two

Using a first fit algorithm

Job E - 18 hours cannot be completed by Alice or John so is scheduled for Ali leaving 12 hours.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)																6 hours
Ali	Job E (18)																														12 hours
Jasmin																															30 hours
Robyn																															30 hours

Task Two

Using a first fit algorithm

Job F - 8 hours - cannot be completed by Alice or John so is scheduled for Ali leaving 4 hours.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)																6 hours
Ali	Job E (18)																		Job F (8)												4 hours
Jasmin																															30 hours
Robyn																															30 hours

Task Two

Using a first fit algorithm

Job G - 6 hours - cannot be completed by Alice but can be completed by John.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)														Job G (6)		0 hours
Ali	Job E (18)																		Job F (8)												4 hours
Jasmin																															30 hours
Robyn																															30 hours

Task Two

Using a first fit algorithm

Job H - 12 hours - cannot be completed by Alice, John or Ali so is scheduled for Jasmin leaving 18 hours available for her.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)										Job G (6)						0 hours
Ali	Job E (18)																		Job F (8)												4 hours
Jasmin	Job H (12)																														18 hours
Robyn																															30 hours

STEM LEARNING

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Task Two

Using a first fit algorithm

Job I - 10 hours - cannot be completed by Alice, John or Ali so is scheduled for Jasmin leaving 8 hours available.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)										Job G (6)						0 hours
Ali	Job E (18)																		Job F (8)												4 hours
Jasmin	Job H (12)												Job I (10)																		8 hours
Robyn																															30 hours

STEM LEARNING

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Task Two

Using a first fit algorithm

Job J - 12 hours cannot be completed by workers Alice, John, Ali or Jasmine so is scheduled for Robyn leaving 18 hours available.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)										Job G (6)						0 hours
Ali	Job E (18)																		Job F (8)												4 hours
Jasmin	Job H (12)												Job I (10)																		8 hours
Robyn	Job J (12)																														18 hours

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Task Two

Using a first fit algorithm

This solution uses 5 employees. However, Alice, Ali and Jasmin have 14 hours available between them. **Can a solution be found which only uses 4 workers?**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job A (16)																Job B (12)														2 hours
John	Job C (14)														Job D (10)										Job G (6)						0 hours
Ali	Job E (18)																		Job F (8)												4 hours
Jasmin	Job H (12)												Job I (10)																		8 hours
Robyn	Job J (12)																														18 hours

Task Three

Using a first fit decreasing algorithm

The first step is to reorder the jobs into decreasing order based upon the time each job will take.

Job	Time required to complete the job (minutes)
E	18
A	16
C	14
B	12
H	12
J	12
D	10
I	10
F	8
G	6

Task Three: Schedule the employees

Using a first fit decreasing algorithm

Apply the first fit algorithm using the jobs in the new order.
Which algorithm works better in this situation?

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice																															30 hours
John																															30 hours
Ali																															30 hours
Jasmin																															30 hours
Robyn																															30 hours

Task Three

Using a first fit decreasing algorithm

Using this algorithm produces the following solution which only requires 4 employees.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hours available
Alice	Job E (18)																		Job B (12)												0 hours
John	Job A (16)																Job C (14)														0 hours
Ali	Job H (12)												Job J (12)												Job G (6)						0 hours
Jasmin	Job D (10)										Job I (10)											Job F (8)									2 hours
Robyn																															30 hours