



IPO CHARTS, PSEUDOCODE & DESK CHECKING

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IPO CHARTS – WHAT ARE THEY

- Used to help you understand a simple computer problem
- Helps formulate the design of a solution
- Lead directly to pseudocode (algorithm to solve the problem)

- I stands for Input
- P stands for Process
- O stands for Output



INPUTS

- Inputs are the data needed to achieve your outputs
- The data you need to process
- It may be entered by a user or it may not
- Example: Find your BMI (Body Mass Index) using the formula:
 - $BMI = 703 (weight / (height * height))$
 - What are the inputs?
 - weight & height
 - These are the inputs needed to produce the desired output
- Another example: Calculate the area of a circle
 - What are the inputs?
 - radius of the circle & pi



OUTPUTS

- Outputs are what the user wants to get from the program – the desired results
- In the example of calculating the BMI, the output would be the BMI
- In the calculating the area of a circle example, the output would be the area
- It is best to find the output first and then decide what inputs are needed to achieve the outputs desired.



PROCESS

- If your calculations are complex and you need to store information that does not need to be outputted, you would have process items.
- Example: find the average of a set of 10 grades
 - Your output would be the average
 - Your inputs would be the actual grades and the number of grades, which equals 10 in this example
 - Your processing item would be the sum of the grades
 - You would store the sum of the grades internally in the program.
 - You do not need to output this amount and it is not an input amount. It is just a useful storage of information so that you can complete your calculations



IPO CHART EXAMPLE

- Example 1 – Create a program to calculate the batting average of a baseball player. The formula is: $\text{Batting Avg} = \text{Hits} / \text{Times At Bat}$

Input	Process	Output
number of hits	none	batting average
number of times at bat		



IPO CHART EXAMPLE

- Example 2 – Create a program to calculate the kinetic energy of a moving object as well as the object's momentum. The formulas are:
 - kinetic energy = $(1/2)mv^2$
 - momentum = $m \cdot v$
 - where m is mass, v is velocity

Input	Process	Output
mass	none	kinetic energy
velocity		momentum



IPO CHART EXAMPLE

- Example 3 – Create a program to calculate an employee's weekly pay including overtime. You can assume that overtime is hours over 40.

Input	Process	Output
hours worked	overtime pay	weekly pay
pay rate	regular pay	
overtime rate		

- In this example, it helps to calculate overtime pay and regular pay separately and then combine them to calculate weekly pay. The overtime and regular pay would not be outputted, so they are processing items.



IPO CHARTS TO PSEUDOCODE

- Once you formulate an IPO chart, it is easy to then create your pseudocode.
- The inputs become what the inputs to the program or constants for the calculations.
- Process items help to determine your calculations or algorithm.
- Outputs become what you display from the calculations or algorithm.



IPO CHART TO PSEUDOCODE EXAMPLE

- Example 1 – Create a program to calculate the batting average of a baseball player. The formula is: $\text{Batting Avg} = \text{Hits} / \text{Times At Bat}$

Input	Process	Output
number of hits	none	batting average
number of times at bat		

1. Enter the number of hit and the times at bat
2. Calculate the batting average by dividing the number of hits by the number of times at bat
3. Display the batting average



IPO CHART TO PSEUDOCODE EXAMPLE

- Example 2 – Create a program to calculate the kinetic energy of a moving object as well as the object's momentum. The formulas are: kinetic energy = $(1/2)mv^2$ & momentum = $m*v$, where m is mass, v is velocity

Input	Process	Output
mass	none	kinetic energy
velocity		momentum

1. Enter mass and velocity
2. Calculate the kinetic energy by multiplying mass times velocity squared and divide by 2
3. Calculate momentum by multiplying mass times velocity
4. Display the kinetic energy and momentum



IPO CHART TO PSEUDOCODE EXAMPLE

- Example 3 – Create a program to calculate an employee's weekly pay including overtime. You can assume that overtime is hours over 40.

Input	Process	Output
hours worked	overtime pay	weekly pay
pay rate	regular pay	
overtime rate		

1. Enter hours worked and pay rate
2. Overtime rate is time and a half
3. If hours are > 40
 - Calculate regular pay by multiplying pay rate by 40
 - Calculate overtime pay by multiplying (hours worked – 40) by pay rate time 1.5
 - Calculate weekly pay by adding regular pay to overtime pay
4. Else, weekly pay is pay rate times hour worked
5. Display weekly pay



FINISHING UP THE LOGIC – DESK CHECK

- At this point you know your inputs, outputs and pseudocode, you are almost ready to start coding
- However, it is good to desk check your algorithm to make sure that it makes sense and works before you code
- List each input, process and output item and walk through the pseudocode to see if you get the answer you expect



DESK CHECK ALGORITHM EXAMPLE

- Example 1 – Create a program to calculate the batting average of a baseball player. The formula is: $\text{Batting Avg} = \text{Hits} / \text{Times At Bat}$
1. Enter the number of hit and the times at bat
 2. Calculate the batting average by dividing the number of hits by the number of times at bat
 3. Display the batting average

Number of Hits	Number of Times at Bat	Batting Average
34	56	$34/56 = 0.607$
25	75	$25/75 = 0.333$



DESK CHECK ALGORITHM EXAMPLE

- Example 2 – Create a program to calculate the kinetic energy of a moving object as well as the object's momentum. The formulas are: $KE = (1/2)mv^2$ & momentum = $m*v$, where m is mass, v is velocity
1. Enter mass and velocity
 2. Calculate the kinetic energy by multiplying mass times velocity squared and divide by 2
 3. Calculate momentum by multiplying mass times velocity
 4. Display the kinetic energy and momentum

Mass	Velocity	Kinetic Energy	Momentum
34	5	$34*5*5 / 2 = 425$	$34*5 = 170$
65	3	$65*3*3 / 2 = 292.5$	$65*3 = 195$



DESK CHECK ALGORITHM EXAMPLE

- Example 3 – Create a program to calculate an employee's weekly pay including overtime. You can assume that overtime is hours over 40.
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 2. Overtime rate is time and a half
 3. If hours are > 40
 - Calculate regular pay by multiplying pay rate by 40
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 - Calculate weekly pay by adding regular pay to overtime pay
 4. Else, weekly pay is pay rate times hour worked
 5. Display weekly pay

Hours Worked	Pay Rate	Regular Pay	Overtime Pay	Weekly Pay
35	10	$35 * 10 = 350$	$0 * (10 * 1.5) = 0$	$350 + 0 = 350$
42	20	$40 * 20 = 800$	$(42 - 40) * (20 * 1.5) = 60$	$800 + 60 = 860$

