**CS 121 Class Project**

**For the class project you will develop a program for the robot from the first homework (problem 4). Review your design from that assignment and modify it to meet the requirements specified below. You will need to turn in a revised algorithm design for the program which can be done in pseudo code or as a flow diagram. You may work in pairs on this assignment. This assignment will be worth 20 % of you overall grade.**

**Due Date: Design Document – Nov. 19. Final code with test results – Dec. 1.**

**----------------------------------------------------------------------------------------------------------------------------**

Thank you for your purchase of the Baby Block 270 Robot (BB270). In order to use the BB270 you must write a program using the basic robot operations stated below:

* 1. Get Block – Removes and holds one block from the chute
  2. Put Block – Inserts the block currently held by the robot into an **empty** slot.
  3. Switch Blocks – Removes a block currently in a slot and replaces it with the block being held by the robot. When finished the robot is holding the block it just removed from the slot.
  4. Compare Blocks – Compares the value of the block (letter) being held by the robot to that of a block in a slot. (If the block held by the robot is less than **or equal** to the block in the slot the result of the compare is TRUE. If the block held by the robot is greater than the block in the slot the result of the compare is FALSE)
  5. Shift Left – Shift the robotic arm one slot to the left. (Cannot go to the left of slot 1)
  6. Shift Right – Shift the robotic arm one slot to the right. (Cannot go to the right of slot 20)
  7. Test Empty – Determines if a slot is empty. (Returns True if empty or False if the slot contains a block.)

Included with the robot are functions for each of the above operations coded in the C++ Programming Language. The code may be downloaded from the syllabus or from Angel.

To test your robot write a program that will place a series of blocks into 20 slots in alphabetic order. Specifically the robot must be able to accomplish this task according to the following requirements:

1. To begin with all slots must be empty.
2. You may choose any slot as the beginning slot.
3. Blocks will enter the chute in random order.
4. Blocks entering the chute will have a value from ‘A’ through ‘Z ‘. (Uppercase alphabetic characters.)
5. Blocks may repeat. (e.g. there may be two or more blocks with the same letter value.)
6. The robot can carry only one block at a time.
7. The robot can switch the block it is holding with a block in a given slot.
8. The robot can only shift (left or right) one slot at a time. (If you want to shift more than one position you will need to use a loop.)
9. As blocks are placed into the slots they **must be in alphabetic order**. (You are not allowed to randomly place all the blocks and then sort them. )
10. The robot cannot go to the left of slot 1 or to the right of slot 20. (This means that you will have to allow for movement of multiple blocks to the left or right in order to stay within the 20 slots.)
11. You must use the functions provided. However, if you have a better implementation for any of the functions then you may use yours after approval from the instructor.
12. You may (and you will need to ) write additional functions which are composed of calls to the provided functions. For example, to shuffle multiple blocks left or right to open a slot for a new block.

*The Robot Challenge: The team that designs the best program as judged by the fewest movements of the robot will be declared Robot Master. To qualify add code that will count each shift of the robot. The instructor will provide a suite of three test cases for the competition.*

**Here is an example showing an arbitrary input of 20 blocks.**

EXAMPLE: Assume the first block is placed in slot 10. (You may start with any slot you like.)

The following shows the result of placing 20 random input blocks:

Initial Slot Configuration – All empty

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Input block from chute: M

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  |  |  |  |  | **M** |  |  |  |  |  |  |  |  |  |  |

Input block from chute: K

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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  |  |  |  | **K** | M |  |  |  |  |  |  |  |  |  |  |

Input block from chute: D

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  |  |  | **D** | K | M |  |  |  |  |  |  |  |  |  |  |

Input block from chute: P

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  |  |  | D | K | M | **P** |  |  |  |  |  |  |  |  |  |

Input block from chute: R

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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  |  |  | D | K | M | P | **R** |  |  |  |  |  |  |  |  |

Input block from chute: J

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  |  | D | **J** | K | M | P | R |  |  |  |  |  |  |  |  |

Input block from chute: F

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  | D | **F** | J | K | M | P | R |  |  |  |  |  |  |  |  |

Input block from chute: W

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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  |  | D | F | J | K | M | P | R | **W** |  |  |  |  |  |  |  |

Input block from chute: K (Note: The new K could go in either slot 8 or 9)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  | D | F | J | **K** | K | M | P | R | W |  |  |  |  |  |  |  |

Input block from chute: Y

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  | D | F | J | K | K | M | P | R | W | **Y** |  |  |  |  |  |  |

Input block from chute: S

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  | D | F | J | K | K | M | P | R | **S** | W | Y |  |  |  |  |  |

Input block from chute: N

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  |  | D | F | J | K | K | M | **N** | P | R | S | W | Y |  |  |  |  |

Input block from chute: D (Note: The new D could go in either slot 4 or 5)

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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  | D | **D** | F | J | K | K | M | N | P | R | S | W | Y |  |  |  |  |

Input block from chute: X

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  | D | D | F | J | K | K | M | N | P | R | S | W | **X** | Y |  |  |  |

Input block from chute: S (Note: The new S could go in either slot 14 or 15)

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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  | D | D | F | J | K | K | M | N | P | R | S | **S** | W | X | Y |  |  |

Input block from chute: Q

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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  |  | D | D | F | J | K | K | M | N | P | **Q** | R | S | S | W | X | Y |  |

Input block from chute: B

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  | **B** | D | D | F | J | K | K | M | N | P | Q | R | S | S | W | X | Y |  |

Input block from chute: V

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  |  | B | D | D | F | J | K | K | M | N | P | Q | R | S | S | **V** | W | X | Y |

Input block from chute: Z (Note: All blocks must be shifted left to open slot 20 for Z.)

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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot |  | B | D | D | F | J | K | K | M | N | P | Q | R | S | S | V | W | X | Y | **Z** |

Input block from chute: G

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Slot | B | D | D | F | **G** | J | K | K | M | N | P | Q | R | S | S | V | W | X | Y | Z |