

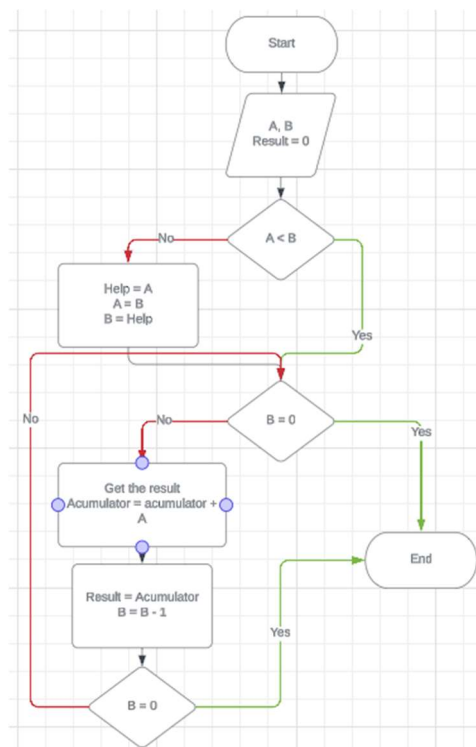
Johnny – Better Multiplication Program

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1. Task:

Create a program in Johnny to do optimized multiplication of two numbers.

2. Flowchart:



3. Solution:

To begin, we set two operands A and B and initialize the result to 0. We first check if A is smaller than B. If A is smaller, we proceed; otherwise, we swap the values of A and B. Next, we check if B equals 0. If B is 0, the program ends; otherwise, we continue with the following instructions:

1. Retrieve the value of A and add it to the accumulator. This marks the beginning of our loop.
2. Update the result by assigning the value of the accumulator to it and decrease B.

Program:

- Check if B equals 0. If B is not 0, return to the beginning of the loop and repeat the previous instructions. If B equals 0, end the program. We place 4 in address 020 and 5 in address 021, representing the operands for multiplication, while the result is stored in address 022.

020				
Adr	Hi	Lo	Asm	Opnd
000:	01	020	TAKE	020
001:	03	021	SUB	021
002:	04	022	SAVE	022
003:	06	022	TST	022
004:	05	011	JMP	011
005:	01	021	TAKE	021
006:	04	022	SAVE	022
007:	01	020	TAKE	020
017:	04	022	SAVE	022
018:	08	021	DEC	021
019:	05	012	JMP	012
020:	00	005		
021:	00	003		
00 005				

- We start by taking the value from address 020, subtracting the value from address 021, and saving the result in address 022. If the result is 0, we swap the values of the two numbers.

022				
Adr	Hi	Lo	Asm	Opnd
000:	01	020	TAKE	020
001:	03	021	SUB	021
002:	04	022	SAVE	022
003:	06	022	TST	022
004:	05	011	JMP	011
005:	01	021	TAKE	021
006:	04	022	SAVE	022
007:	01	020	TAKE	020
019:	05	012	JMP	012
020:	00	005		
021:	00	003		
022:	00	002		
023:	00	000		
00 002				

- Then we check if the smaller number is 0. If it is, the program ends. If not, we proceed with the multiplication as in the previous task.

021					
Adr	Hi	Lo	Asm	Opnd	
012:	06	021	TST	021	
013:	05	015	JMP	015	
014:	10	000	HLT	000	
015:	01	022	TAKE	022	
016:	02	020	ADD	020	
017:	04	022	SAVE	022	
018:	08	021	DEC	021	
019:	05	012	JMP	012	
019:	05	012	JMP	012	
020:	00	005			
021:	00	000			
022:	00	015			
023:	00	000			
00 000					