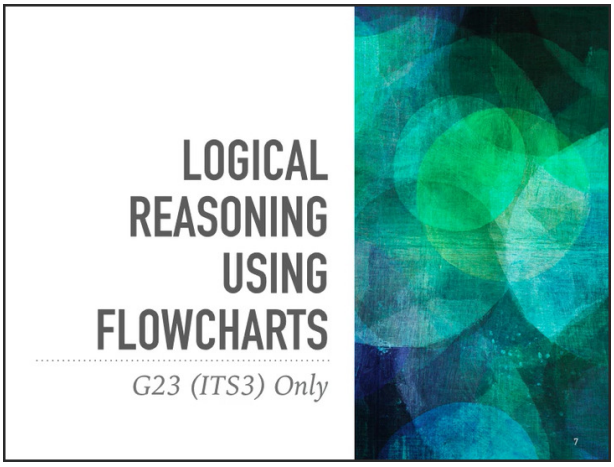
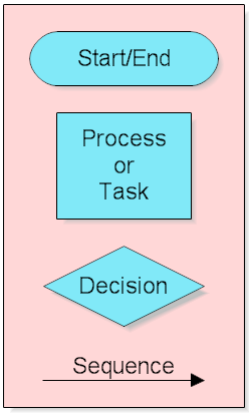
See also: https://vimeo.com/234594828



Basic shapes

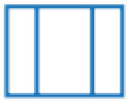


https://www.rff.com/flowchart_shapes.php

The Definitive Flow Chart Cheat Sheet

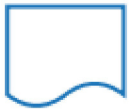
Start/End
The beginning or end of any flow

Process
Any action or moment in the flow



Predefined Process
Pre-existing subprocess that isn't described in this diagram

Decision
Branching point, followed by two or more paths

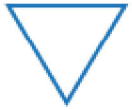


Document
Any brief, form, or other document

Multiple Documents
Multiple briefs, forms, or other documents

Preparation
Set-up necessary for the rest of the flow

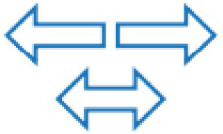
Delay
Any waiting period planned into the flow



Merge
The point where separate processes come together

Connector
A jump between separated sections of the flow on one page

Off-page Connector
Flow continues on the next page/from the previous page



Arrows
Bold alternatives to standard connectors

Data Symbols

Specific to technical flows, these shapes indicate data flow, storage, and display.

Loop Limit
The beginning (or end) of a looped process

Display
Information displayed to a user

Input/Output
Data added to the flow or resulting from the flow

Manual Input
Data that must be entered at a prompt, e.g., filling out a form

Manual Operation
Any adjustment to the flow that must be made manually

Paper Tape
Input into an older computer system

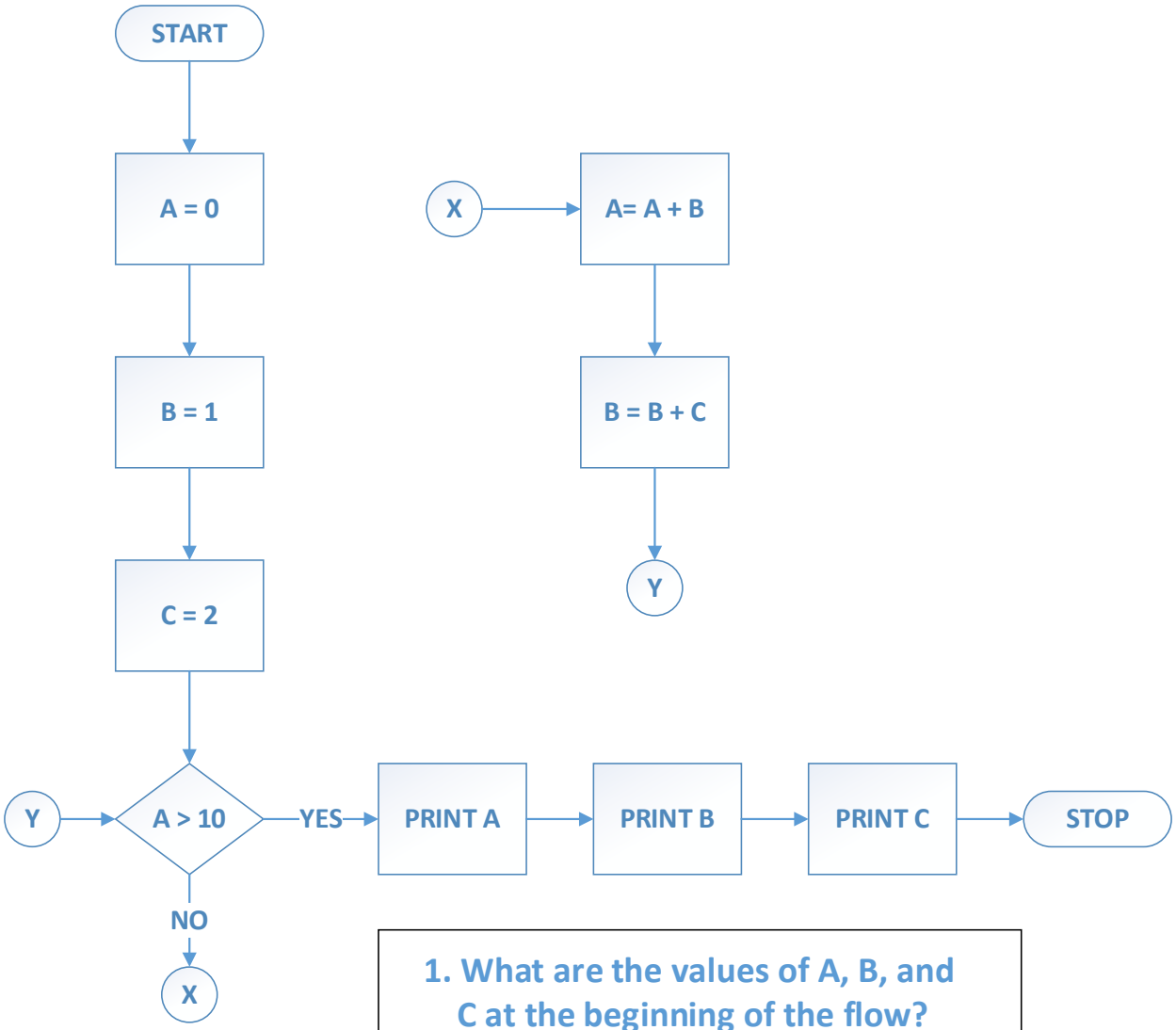
Card
Job control card for mainframe batch processing flows

Data Storage
Data stored in any format

Internal Storage
Data stored locally, not as a remote file

Database
Data that can be accessed in any order

Tape Data
Data that must be accessed sequentially

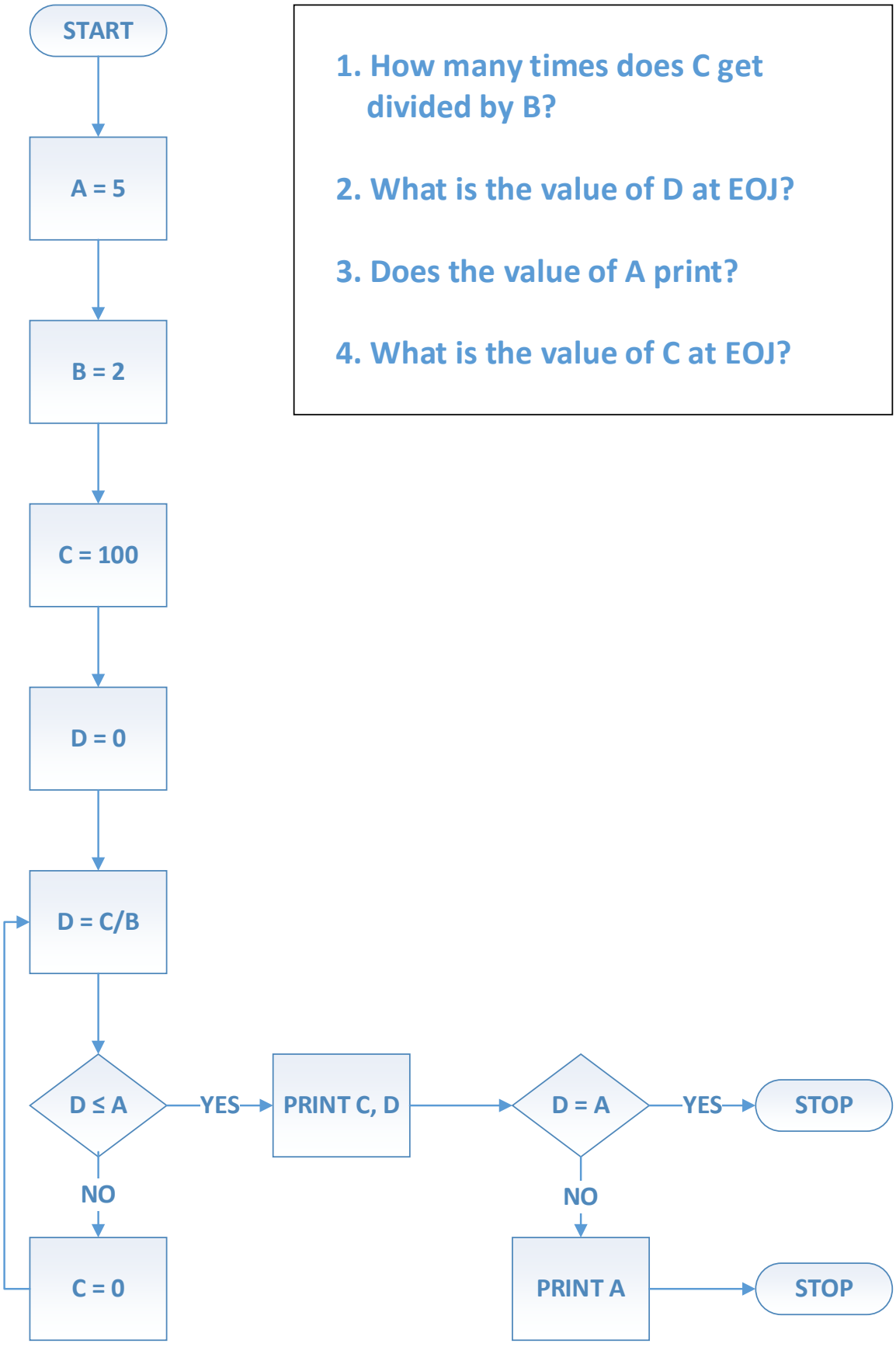


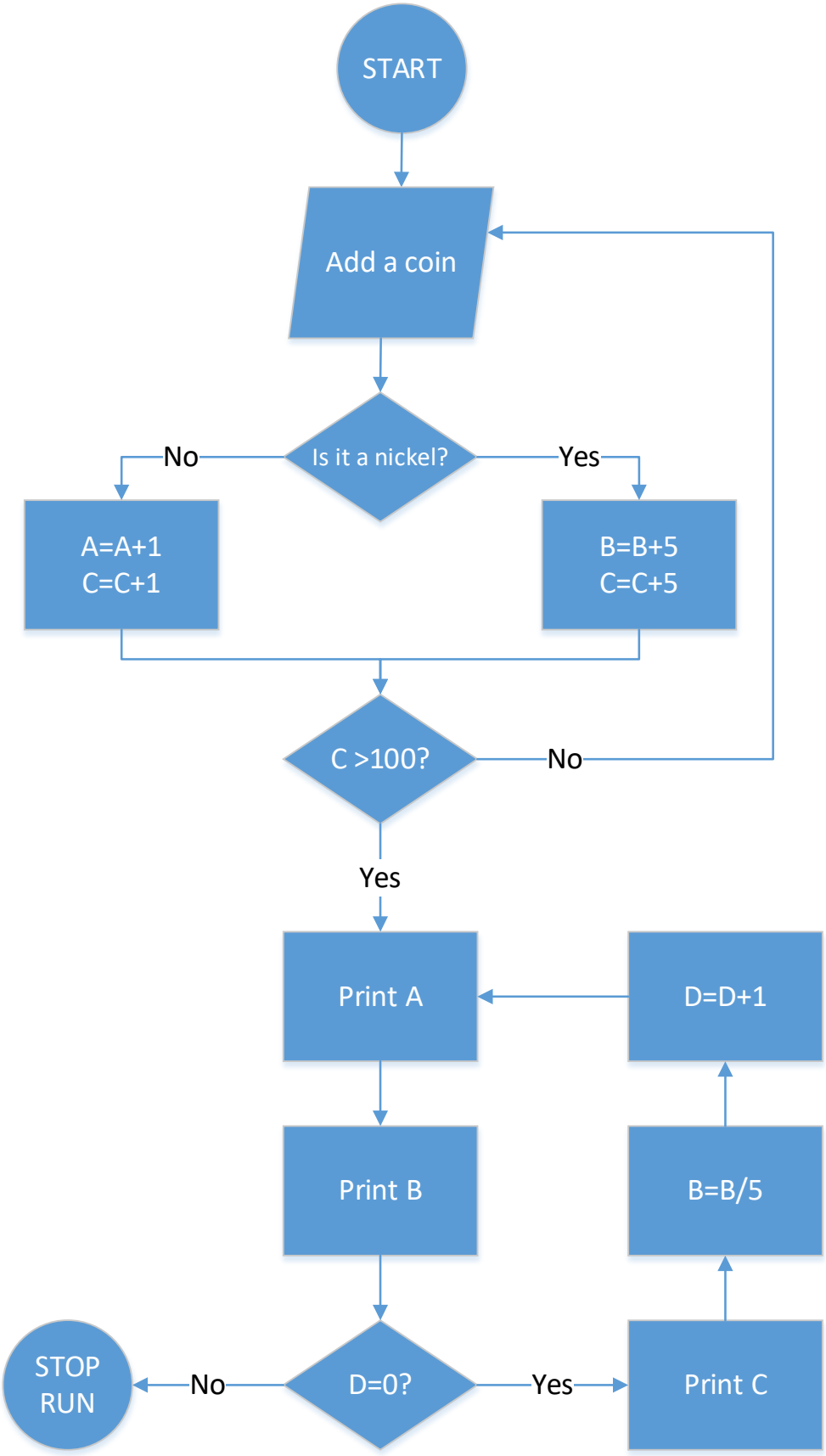
1. What are the values of A, B, and C at the beginning of the flow?

2. What are the values of A, B, and C at the end of the flow?

3. How many times does the process “A = A + B” get executed?

1. How many times does C get divided by B?
2. What is the value of D at EOJ?
3. Does the value of A print?
4. What is the value of C at EOJ?




START
Add a coin
Is it a nickel?
No
Yes
A=A+1
C=C+1
B=B+5
C=C+5
C >100?
No
Yes
Print A
D=D+1
Print B
B=B/5
STOP
RUN
No
D=0?
Yes
Print C

The “Coin Problem” flowchart will be used to answer questions 172 thru 174. The “ADD A COIN” procedure assumes that the coin being added is either a nickel or a penny. Assume all counters have been initialized to zero.

172. The box labeled “PRINT A” when first executed prints out the following:

a) The number of pennies collected
b) The amount of money collected in nickels
c) The total amount of money
d) The number of nickels collected

173. The box labeled “PRINT B” when executed for the last time will print out the following:

a) The number of pennies collected
b) The amount of money collected in nickels
c) The total amount of money
d) The number of nickels collected

174. If there were 27 coins processed and the last 3 coins were nickel, penny, nickel, what would C equal at the end of the job?

a) 101
b) 102
c) 103
d) 107

```
 1 ------------------------------------------------------------------------------
 2 Question 1 Work
 3 ------------------------------------------------------------------------------
 4 start      A=0   B=1  C=2   A>10  A=A+B   B=B+C
 5 iter 1                      N    A=1     B=3
 6 iter 2       1     3    2    N    A=4     B=5
 7 iter 3       4     5    2    N    A=9     B=7
 8 iter 4       9     7    2    N    A=16    B=9
 9 iter 5      16     9    2    Y    -----------
10 iter 6
11 iter 7
12
13 ------------------------------------------------------------------------------
14 Question 1 Answers
15 ------------------------------------------------------------------------------
16 1) null / undefined / unknown
17 2) A=16, B=9, C=2
18 3) 4 times
19
20 ------------------------------------------------------------------------------
21 Question 2 Work
22 ------------------------------------------------------------------------------
23            iter 1            iter 2      end
24 A          5                 5           5
25 B          2                 2           2
26 C          100               0           0
27 D          0                 50          0
28 -loop-
29 D=C/B      D=100/2=50        D=0/2=0
30 D<=A?      50<=5? NO         0<=5? YES
31 C=0        C = 0             ---------
32 -loop-
33 PRINT C,D                    PRINT 0,0
34 D=A?                         0=5? NO
35 PRINT A                      PRINT 5
36
37 ------------------------------------------------------------------------------
38 Question 2 Answers
39 ------------------------------------------------------------------------------
40 1) 2 times
41 2) 0
42 3) yes
43 4) 0
44
45 ------------------------------------------------------------------------------
46 Coin Counter Work
47 ------------------------------------------------------------------------------
48               P   N   N    N  ...  N
49 A         0   0   1   1    1       1    # or value of P
50 B         0   0   0   5    10      95   value of N
51 C         0   0   1   6    11      96   total value
52 D         0   0   0   0    0       0
53 -loop-
54 Nickel?       N   Y   Y    Y       Y
55 Y B=B+5           B=5 B=10 B=15    B=100
56 Y C=C+5           C=6 C=11 C=16    C=101
57 N A=A+1       A=1
```

```
N C=C+1       C=1
C>100?        N   N   N    N       Y
-loop-                            ---
PRINT A                            1    # or value of P
PRINT B                            100  value of N
D=0?                               Y
PRINT C                            101  total value
B=B/5                              B=20 # of N
D=D+1                              D=1
PRINT A                            1    # or value of P
PRINT B                            20   # of N
D=0?                               N
STOP**********************************
```

Coin Counter Answers

---

172) a) the number of pennies collected
173) d) the number of nickels collected
174) c) 103

Explanation for 174

If there were 27 coins processed, and the last 3 coins were N, P, N:

```
1
2
3
...
25  N
26  P   <-- total must be 100 at most, or we wouldn't add another coin
            total must also be at least 96 so next N will be final coin
27  N   <-- based on above, total must be between 101 and 105
            this immediately eliminates answer choice d
```

Working backwards,
We want the total of 26 coins to total between 96 and 100. (based on above)
We want the total of 25 coins to be between 95 and 99. (subtracted a P)
We want the total of 24 coins to be between 90 and 94. (subtracted a N)

We can look at different combinations of 24 coins to see where the totals fall.
Let's start with all nickels (24 N, 0 P).

# of N	value of N	# of P	Total	
24	120	0	120	-- too high, try fewer nickels
23	115	1	116	-- still too high, keep going
20	100	4	104	
18	90	6	96	
17	85	7	92	

If we have 17 N and 7 P, the total of 24 coins will be 92.

Once we add back in coins 25, 26, and 27 (N, P, N):
92 + 5 + 1 + 5 = 103.