1 Register machine A

Give a full description of a register machine $RM_A$ that, on input $x$ in register 1, halts when $x$ is equal to 2 modulo 5 and never stops otherwise. (Note, all other registers are empty. The same goes for the other machines in the other exercises.)

2 Register machine B

What does the following register machine do on input $x$ in register $r_1$, $s_1$ being the starting state? Briefly explain your answer.

$RM_B = (\{s_1, s_2, s_3\}, \{r_1, r_2\})$

Where $s_1$ is the instruction $s_1 : r_1 - -; s_2 ; s_3$, the instruction $s_2$ is defined as $s_2 : r_2 + +; s_1$ and the instruction $s_3$ is the halting state.

3 Register machine C

Give a description of a register machine $RM_C$ that, on input $x$ in register 1, increases some register $r_i$ to the value $\left(\frac{x}{2}\right)$ and sets all other registers equal to zero before halting.

4 Register machine D

What does the following register machine do on input $x$ in register $r_1$, where $s_a$ is the starting state? Briefly explain your answer.

$RM_D = (\{s_a, s_0, s_1, s_2, s_3, s_{c1}, s_{c2}, s_{stop}\}, \{r_1, r_2, r_3\})$

Where we have:

$s_a : r_2 + +; s_0$
$s_0 : r_1 - -; s_1; s_{stop}$
$s_1 : r_2 - -; s_2; s_{c1}$
$s_2 : r_3 + +; s_3$
$s_3 : r_3 + +; s_1$
$s_{c1} : r_3 - -; s_{c2}; s_0$
$s_{c2} : r_2 + +; s_{c1}$
$s_{stop} : STOP$

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A full description of the machine can be rather lengthy, so it suffices to describe what the machine does while making clear that it is possible to do this on a register machine.