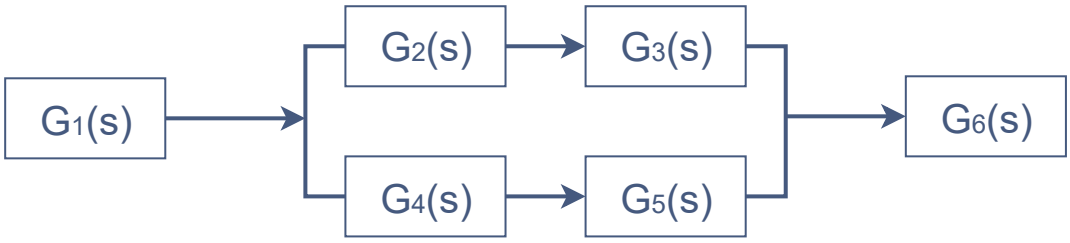
Exercise: Transfer Functions

In this exercise, you will solve tasks related to transfer functions.

WE'LL COVER THE FOLLOWING

Task 1

The following is a combination of different transfer functions in series and parallel. The value of each transfer function is given below.



$$G_1(s) = \frac{1}{s} \quad G_2(s) = \frac{1}{s+1} \quad G_3(s) = \frac{s}{s+2}$$

$$G_4(s) = 4 \quad G_5(s) = \frac{1}{s^2+1} \quad G_6(s) = 3s$$

Problem statement

Find the transfer function of the system, displayed as **one fraction**, by

applying the rules we studied in the previous lesson.

> 💡 Use all the suitable packages that you have learned throughout the course.

```
# write your code here
```

Task 2

The poles and zeros of a transfer function are the roots of the denominator and the numerator, respectively.

Problem statement

Find the poles and zeros of the transfer function of the system above and make sure their data type is `complex`.

> The hint below will help you get started if you are stuck.

Show Hint

> 💡 Use all the suitable packages that you have learned throughout the course

```
# write your code here
```

Task 3

As you can see above, poles and zeros of a system can be real or complex.

Problem statement

Make a scatter plot the poles and zeros of the system on a complex plane,that is, the y-axis is imaginary and the x-axis is real.

- Use the `x` to represent the poles.
- Use the `o` to represent the zeros.

Requirements for the plot:

1. axes labels
2. titles
3. lines at $y = 0$ and $x = 0$
4. legend

> 💡 Use all the suitable packages that you have learned throughout the course.

> ➡️ To display the plot, don't forget to use the `plt.savefig(output/filename.png)` command to save the figure to the output folder.

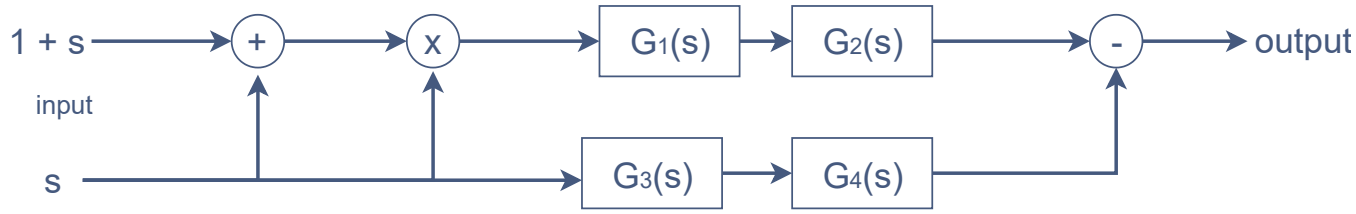
```
# write your code here
```

Task 4

Now, let's solve a problem with an input to a system of transfer functions. You will need to design the logic to compute the output.

Problem statement

1. Find the resulting output signal as a single fraction in terms of s.
2. Find the value of the output signal for $s = 1$.



$$G_1(s) = \frac{1}{s} \quad G_2(s) = \frac{1}{s+1} \quad G_3(s) = \frac{1}{s^2+2} \quad G_4(s) = 4$$

> 💡 Use all the suitable packages that you have learned throughout the course.

```
# write you coder here
```

Solutions to these tasks will be discussed in the next lesson.