Foundations of Audio Signal Processing
Assignment 1

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October 26, 2018

1 Complex Numbers

a.

$$\begin{aligned}(4i)\cdot(2+i) &= 8+4i-2i-i^2 \\ &= 8+2i-(\sqrt{-1})^2 \\ &= 8+1+2i \qquad\qquad = 9+2i\end{aligned}$$

b.

$$\begin{aligned}(1+2i)^{-1} &= \frac{1}{(1+2i)}\cdot\frac{(1-2i)}{(1-2i)} \\ &= \frac{1-2i}{1-(2i)^2} \\ &= \frac{1-2i}{1+4} \qquad\qquad = \frac{1}{5}-\frac{2}{5}\cdot i\end{aligned}$$

c.

$$\begin{aligned}e^{2\pi i}+e^{i\pi\frac{3}{2}} &= 2\cdot(\cos(2\pi)+i\cdot\sin(2\pi))+(\cos(\frac{3}{2}\pi)+i\cdot\sin(\frac{3}{2}\pi)) \\ &= 2\cdot(1+0)+(0+i\cdot-1) \qquad\qquad = 2-i\end{aligned}$$

d.

$$\begin{aligned}4\cdot\left(\frac{1-i}{1+i}\right)^2 &= 4\cdot\frac{(1-i)^2}{(1+i)^2} \\ &= 4\cdot\frac{1-2i+i^2}{1+2i+i^2} \\ &= 4\cdot\frac{1-2i-1}{1+2i+-1} \\ &= 4\cdot\frac{1-2i-1}{1+2i+-1} \\ &= 4\cdot\frac{-2i}{2i} \qquad\qquad = -4+0i\end{aligned}$$

2 Matlab

a-b. The solutions can be found inside the `code` folder.
Sample run of our program with two complex numbers:

```
» c1 = 3/4 + 2 * pi *i
c1 = 0.75000 + 6.28319i
» c2 = 7 + (1/2)*i
c2 = 7.00000 + 0.50000i
» Sheet1Exercise2(c1, c2)
prod = 2.1084 + 44.3573i
quot = 0.17039 + 0.88543i
```

In Figure 1 it is possible to see the result of our program with the above complex numbers.

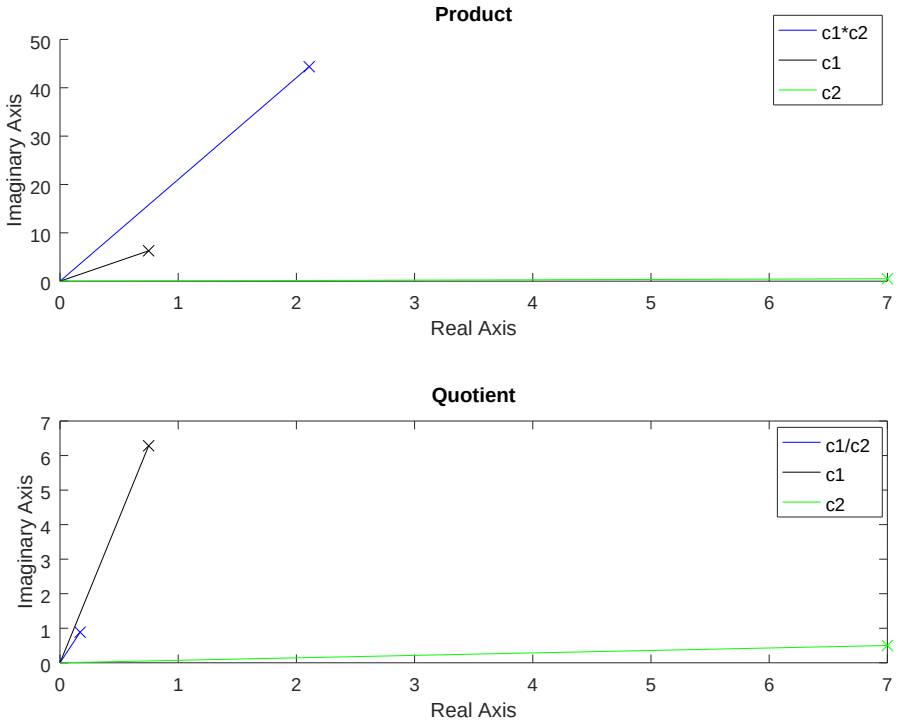

Figure 1: Representations of product and quotient of two given complex numbers.