

Foundations of Audio Signal Processing

Assignment 1

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1 Complex Numbers

a.

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

b.

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

c.

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

d.

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

2 Matlab

a-b. The solutions can be found inside the `code` folder.

Example 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
```

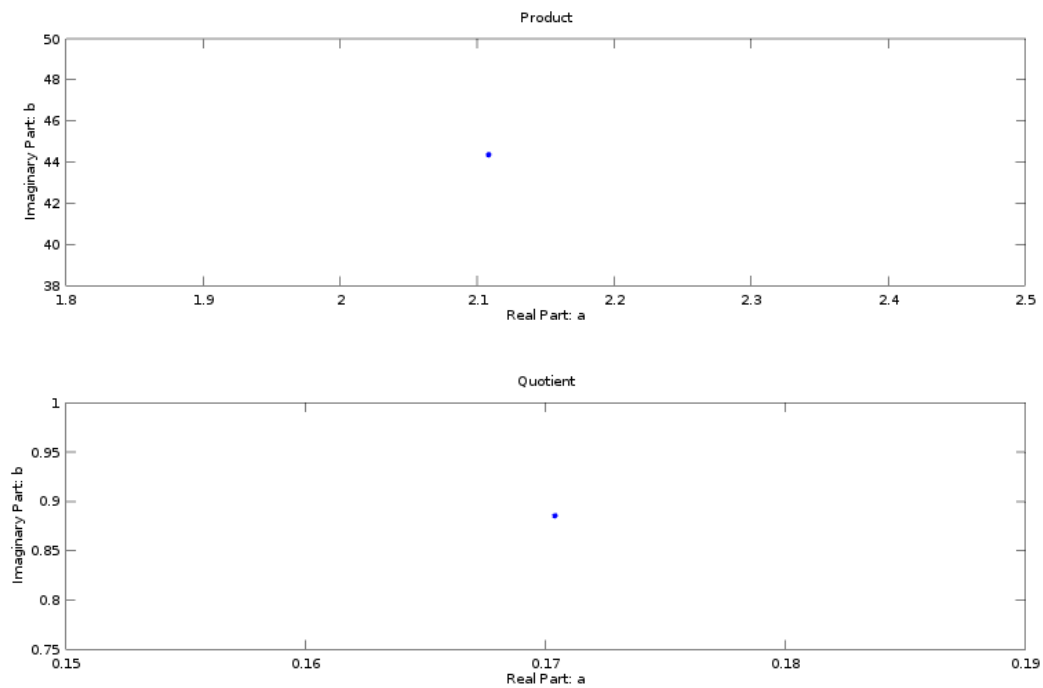


Figure 1: Representations of product and quotient of two given complex numbers.