Math Document Template

C ANISH

***Abstract*—This is a document explaining a question about the concept of sum of angles in a triangle.**

Download all python codes from

```
svn co https://github.com/chakki1234/summer
    -2020/trunk/linearalg/codes
```

and latex-tikz codes from

```
svn co https://github.com/chakki1234/summer
    -2020/trunk/linearalg/figs
```

1 Problem

In a $\triangle ABC$, $\angle C = 3\angle B = 2(\angle A + \angle B)$. Find the three angles.

2 Construction

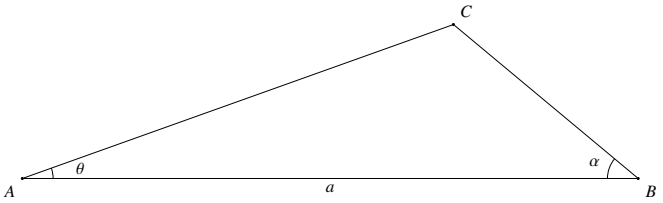

Fig. 2.0: Triangle by Latex-Tikz

2.1. The figure obtained looks like Fig. 2.0.

2.2. The design parameters used for construction See Table. 2.2.

Design Parameters	
Parameters	Value
a	10

TABLE 2.2: Triangle ABC

2.3. To find the coordinates of **C** in Fig 2.0
Solution:

$$\mathbf{A} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{2.3.1}$$

$$\mathbf{B} = \begin{pmatrix} b \\ 0 \end{pmatrix} \tag{2.3.2}$$

$$\mathbf{C} = \begin{pmatrix} x \\ y \end{pmatrix} \tag{2.3.3}$$

Finding the Scalar Products:

$$(\mathbf{B}-\mathbf{A})^T(\mathbf{C}-\mathbf{A}) = \|\mathbf{B}-\mathbf{A}\|\,\|\mathbf{C}-\mathbf{A}\|\cos\theta \tag{2.3.4}$$

$$(\mathbf{C}-\mathbf{B})^T(\mathbf{A}-\mathbf{B}) = \|\mathbf{C}-\mathbf{B}\|\,\|\mathbf{A}-\mathbf{B}\|\cos\alpha \tag{2.3.5}$$

On simplifying equation 2.3.4 and 2.3.5:

$$x^2\tan\theta^2 = y^2 \tag{2.3.6}$$

$$(x-a)^2 = \left((x-a)^2+y^2\right)\cos\alpha^2 \tag{2.3.7}$$

Substituting 2.3.6 in 2.3.7:

$$x^2\left(1-\cos\alpha^2-\tan\theta^2\cos\alpha^2\right) + x\left(2a\cos\alpha^2-2a\right)+a^2\sin\alpha^2 \tag{2.3.8}$$

If θ and α are accute angles:

$$x = \frac{\left(-b-\sqrt{b^2-4ac}\right)}{2a} \tag{2.3.9}$$

else:

$$x = \frac{\left(-b+\sqrt{b^2-4ac}\right)}{2a} \tag{2.3.10}$$

The value of x can then be substituted in 2.3.6 to find the coordinates of **C**

2.4. From the given information, The values are listed in 2.4

Output values	
Parameter	Value
C	$\begin{pmatrix} 7 \\ 2.5 \end{pmatrix}$

TABLE 2.4: Values of **C**

2.5. Draw Fig. 2.5.

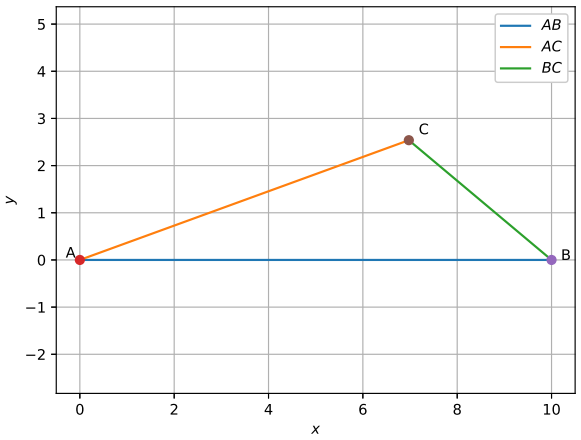

Fig. 2.5: Triangle generated using python

Solution: The following Python code generates Fig. 2.5

codes/triangle_linearalg.py

and the equivalent latex-tikz code generating Fig. 2.5 is

figs/triangle_fig.tex

The above latex code can be compiled as a standalone document as

figs/triangle_final.tex

3 Solution

Theorem 3.1. *Sum of all angles in a triangle equals* 180°.

Solution: From theorem 3.1

$$\angle A + \angle B + \angle C = 180^\circ \tag{5.1}$$

From the given information:

$$\frac{\angle C}{6} + \frac{\angle C}{3} + \angle C = 180^\circ \tag{5.2}$$

$$\therefore \angle C = 120^\circ \ \angle A = 20^\circ \ \angle B = 40^\circ$$