Meccano octagons

https://github.com/heptagons/meccano/octa

1 Meccano octagons

Figure 1 is the meccano octagon plan which joins two triangles to form an angle of $45° + 90°$.

1.1 Finding octagons rods

Next golang program find first cases:

```
func octagons_2() {
  for i := 1; i < 60; i++ {
    for j := 1; j < i; j++ {
      test := i*i - j*j
      if test % 2 == 0 {
        f := math.Sqrt(float64(test / 2))
        k := int(f)
        if f == float64(k) {
          if gcd(k, gcd(j, i)) == 1 {
            fmt.Printf("CD=%2d BC=%2d AB=AD=%2d\n", i, j, k)
          }
        }
      }
    }
  }
}
func gcd(a, b int) int {
  if b == 0 {
    return a
```

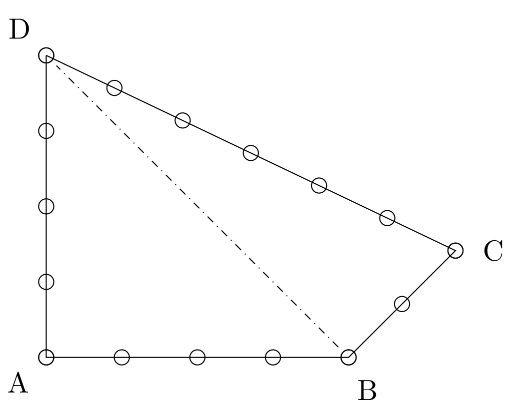

Figure 1: Meccano octagon plan. Isosceles right triangle ABD has side equals to 4 and hypothenuse BD equals $4\sqrt{2}$. Next to this triangle we form another right triangle BCD with sides 2, 6 and $4\sqrt{2}$. ABC is the internal regular octagon angle since angle $ABC = 45°$ and $DBC = 90°$.

```
  } else {
    return gcd(b, a % b)
  }
}
```

The program iterates on i and j which corresponds to segments $\overline{CD}$ and $\overline{BC}$. Then the hipothenuse $\overline{DB}$ is checked to be $\sqrt{2} \times \overline{AB}$ being $\overline{AB}$ and integer.

1.2 Rods results

Program's first results are:

```
CD= 3 BC= 1 AB=AD= 2
CD= 9 BC= 7 AB=AD= 4
CD=11 BC= 7 AB=AD= 6
CD=17 BC= 1 AB=AD=12
CD=19 BC=17 AB=AD= 6
CD=27 BC=23 AB=AD=10
CD=33 BC=17 AB=AD=20
CD=33 BC=31 AB=AD= 8
CD=41 BC=23 AB=AD=24
CD=43 BC= 7 AB=AD=30
CD=51 BC=47 AB=AD=14
CD=51 BC=49 AB=AD=10
CD=57 BC= 7 AB=AD=40
CD=57 BC=41 AB=AD=28
CD=59 BC=41 AB=AD=30
```

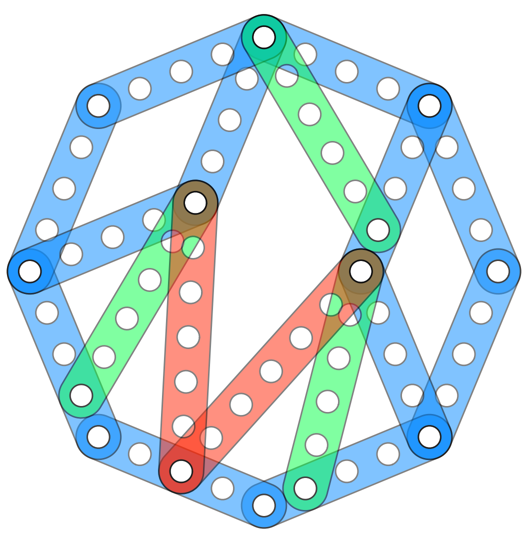

Figure 2: Smallest octagon. From first result $CD = 3, BC = 1, AB = AD = 2$, we scale by 2 to get $CD = 6, BC = 2, AB = AD = 4$ to have a buildable octagon.

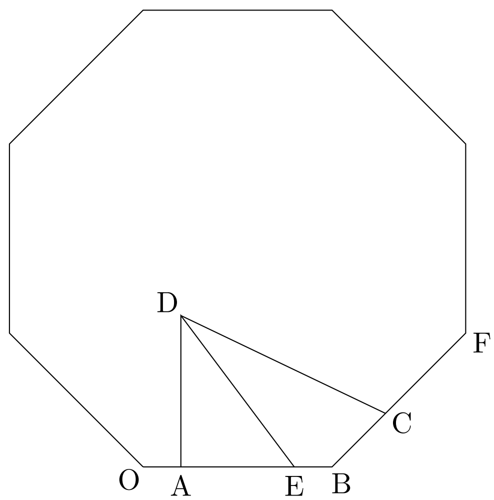

Figure 3: Meccano octagon of size 5 with layout of octagon of size 4. Maximum rod size is $\overline{CD} = 6$. Octagon sizes are $\overline{OB} = \overline{BF} = 5$. $\overline{BE} = 1$, $\overline{DE} = 5$ and $\overline{AD} = 4$.

1.3 Octagon of side 4

At figure 2 we have the smallest octagon of length side 4. For this octagon we take the first result scaled by a factor of 2 in order we can have a right triange large enough to be fixed by a $3 - 4 - 5$ triangle (hypothenuse in color green).

1.4 Octagons of sides 5 and 6

At figure 3 we have an octagon of size 5 using the layout of octagon of size 4. At figure 4 we have an octagon of size 6 using the layout of octagon of size 4.

1.5 Octagons of side 7

At figure 5 we have an octagon of size 7 using the program's second result $CD = 9BC = 7AB = AD = 4$. At figure 6 we have an octagon of size 7 using the program's third result $CD = 11BC = 7AB = AD = 6$.

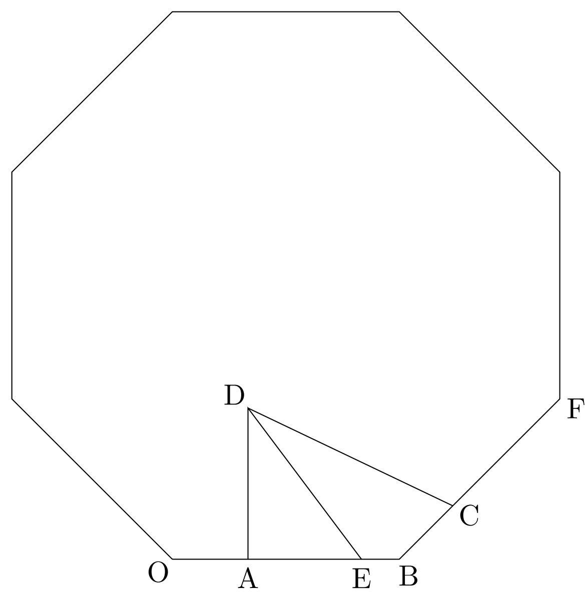

Figure 4: Meccano octagon of size 6 with layout of octagon of size 4. Maximum rods sizes are $\overline{OB} = \overline{BF} = \overline{CD} = 6$. $\overline{BE} = 1$, $\overline{DE} = 5$ and $\overline{AD} = 4$.

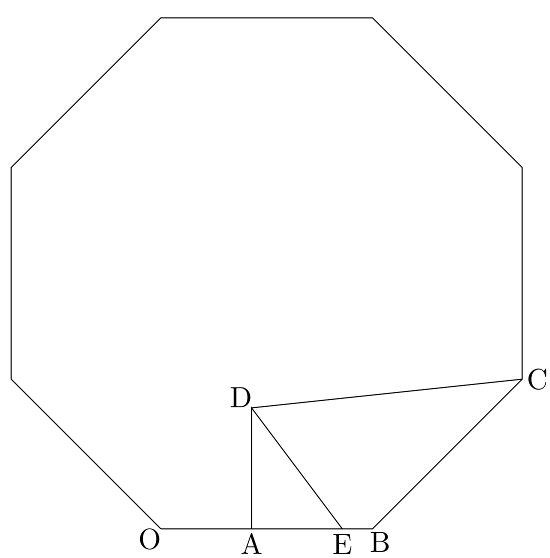

Figure 5: First meccano octagon of size 7. Size is $\overline{OB} = \overline{BC} = 7$. Largest rod is $\overline{CD} = 9$. Support bars are $\overline{AD} = 4$ and $\overline{DE} = 5$ so distance $\overline{AE} = 3$ while distance $\overline{AB} = \overline{AE} = 4$.

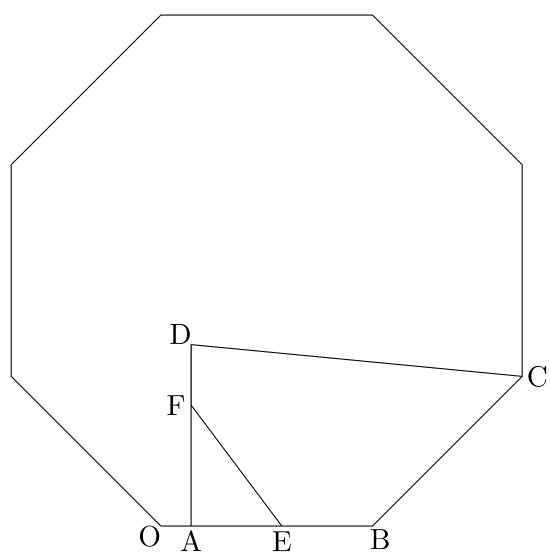

Figure 6: Second meccano octagon of size 7. Size is $\overline{OB} = \overline{BC} = 7$. Largest rod is $\overline{CD} = 11$. Support bars are $\overline{AF} = 4$ and $\overline{FE} = 5$ so distance $\overline{AE} = 3$ while distance $\overline{AB} = \overline{AD} = 6$.