Типове, функции, граматики

Калин Георгиев

16 октомври 2019 г.

Типове в езиците за програмиране

Абстрактна необходимост

- Моделиране
- Различни физически характеристики на свойствата на реалните обекти
- Физически и абстрактни свойства (тегло vs. име)

- Авто къща
- Авто морга
- Завод

Абстрактна необходимост

- Моделиране
- Различни физически характеристики на свойствата на реалните обекти
- Физически и абстрактни свойства (тегло vs. име)

- Авто къща
- Авто морга
- Завод

Абстрактна необходимост

- Моделиране
- Различни физически характеристики на свойствата на реалните обекти
- Физически и абстрактни свойства (тегло vs. име)

- Авто къща
- Авто морга
- Завод

Абстрактна необходимост

- Моделиране
- Различни физически характеристики на свойствата на реалните обекти
- Физически и абстрактни свойства (тегло vs. име)

- Авто къща
- Авто морга
- Завод

Машинна необходимост

- Обем памет

$127_{10}=$	1	1	1	1	1	1_2	
$128_{10}=$	1	0	0	0	0	0	0_2

- Приближено представяне на неизброими типове

$$123.45 = \overbrace{12345}^{\text{мантиса}} * \underbrace{10^{-2}}_{\text{експонента}}$$

- Диапазон (range) vs. точност (precision)
- Как представяме $1/3$

Машинна необходимост

- Обем памет

$127_{10}=$	1	1	1	1	1	1_2
$128_{10}=$	1	0	0	0	0	0 0_2

- Приближено представяне на неизброими типове

$$123.45 = \overbrace{12345}^{\text{мантиса}} * \underbrace{10^{-2}}_{\text{експонента}}$$

- Диапазон (range) vs. точност (precision)
- Как представяме 1/3

Машинна необходимост

- Обем памет

$127_{10}=$	1	1	1	1	1	1_2
$128_{10}=$	1	0	0	0	0	0 0_2

- Приближено представяне на неизброими типове

$$123.45 = \overbrace{12345}^{\text{мантиса}} * \underbrace{10^{-2}}_{\text{експонента}}$$

- Диапазон (range) vs. точност (precision)
- Как представяме 1/3

Машинна необходимост

- Обем памет

$127_{10}=$	1	1	1	1	1	1_2
$128_{10}=$	1	0	0	0	0	0 0_2

- Приближено представяне на неизброими типове

$$123.45 = \overbrace{12345}^{\text{мантиса}} * \underbrace{10^{-2}}_{\text{експонента}}$$

- Диапазон (range) vs. точност (precision)
- Как представяме $1/3$

Примери

```
int main ()
{

  int int_a = 1, int_b = 2;
  double dbl_a = 1, dbl_b = 2;
  char chr_a = 'a', chr_b = 'b';


  cout << int_a / int_b << endl;
  cout << dbl_a / dbl_b << endl;
  cout << chr_a << endl;

  int_a = 'a'; //int_a = chr_a;
  cout << int_a << endl;

  chr_a = 65;
  cout << chr_a << endl;

  return 0;
}
```

Математическа характеристика

Множество допустими стойности (Носител - D)

- Мъж, Жена
- 0..255
- $(\mathcal{R}, \mathcal{R}, \mathcal{R})$

Операции

- $f : D \times D \to D$
- $f(x, y) = x + y$

Предикати

- $p : D \to \{tt, ff\}$
- $p(x) = |x|_2 == 0$

Математическа характеристика

Множество допустими стойности (Носител - D)

- Мъж, Жена
- 0..255
- $(\mathcal{R}, \mathcal{R}, \mathcal{R})$

Операции

- $f : D \times D \to D$
- $f(x, y) = x + y$

Предикати

- $p : D \to \{tt, ff\}$
- $p(x) = |x|_2 == 0$

Математическа характеристика

Множество допустими стойности (Носител - D)

- Мъж, Жена
- 0..255
- $(\mathcal{R}, \mathcal{R}, \mathcal{R})$

Операции

- $f : D \times D \to D$
- $f(x, y) = x + y$

Предикати

- $p : D \to \{tt, ff\}$
- $p(x) = |x|_2 == 0$

Математическа характеристика

Множество допустими стойности (Носител - D)

- Мъж, Жена
- 0..255
- $(\mathcal{R}, \mathcal{R}, \mathcal{R})$

Операции

- $f : D \times D \to D$
- $f(x, y) = x + y$

Предикати

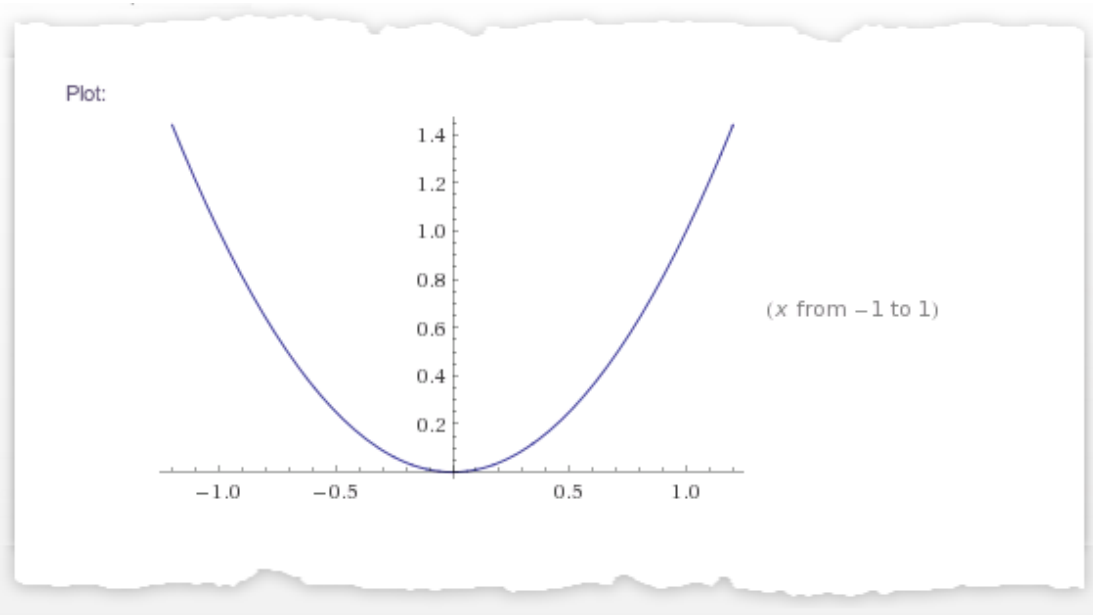
- $p : D \to \{tt, ff\}$
- $p(x) = |x|_2 == 0$

Функции. Подпрограми

Функции в математиката

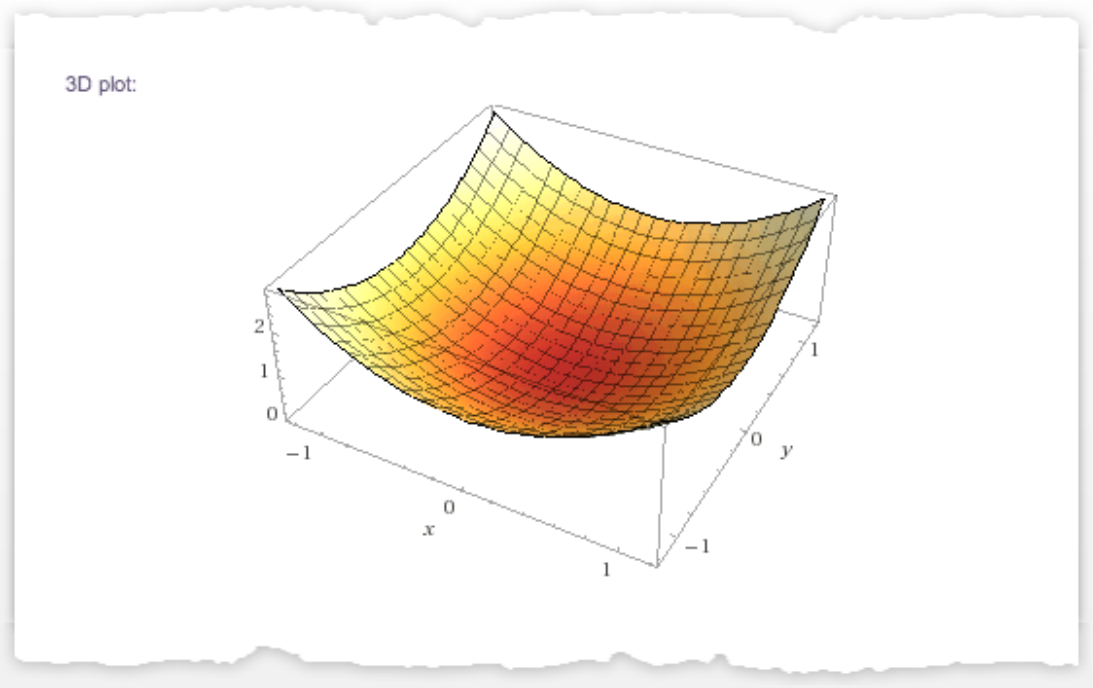
- Дефиниционна област (Domain)
- Множество на стойностите (Range)
- f : **Domain** $\rightarrow$ **Range**

$f(x) = x^2$

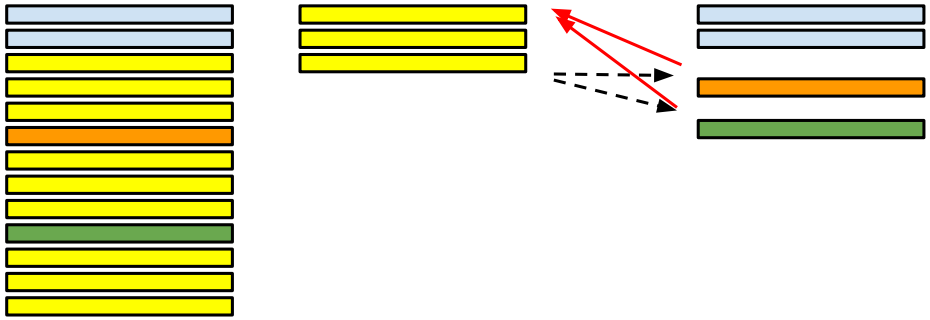


Функции в математиката

$$f(x, y) = x^2 + y^2$$



Подпрограми



Лице на триъгълник по три страни

$a, b, c \in \mathcal{R}$

$$S = \sqrt{\frac{a+b+c}{2}\frac{b+c-a}{2}\frac{a+c-b}{2}\frac{a+b-c}{2}} = \sqrt{p(p-a)(p-b)(p-c)} \in \mathcal{R}$$

$s : \mathcal{R} \times \mathcal{R} \times \mathcal{R} \to \mathcal{R}$

$s(a, b, c) = \sqrt{p(p-a)(p-b)(p-c)}$

Лице на триъгълник по три страни

$a, b, c \in \mathcal{R}$

$$S = \sqrt{\frac{a+b+c}{2}\frac{b+c-a}{2}\frac{a+c-b}{2}\frac{a+b-c}{2}} = \sqrt{p(p-a)(p-b)(p-c)} \in \mathcal{R}$$

$$s : \mathcal{R} \times \mathcal{R} \times \mathcal{R} \to \mathcal{R}$$

$$s(a, b, c) = \sqrt{p(p-a)(p-b)(p-c)}$$

Лице на триъгълник по три страни

$a, b, c \in \mathcal{R}$

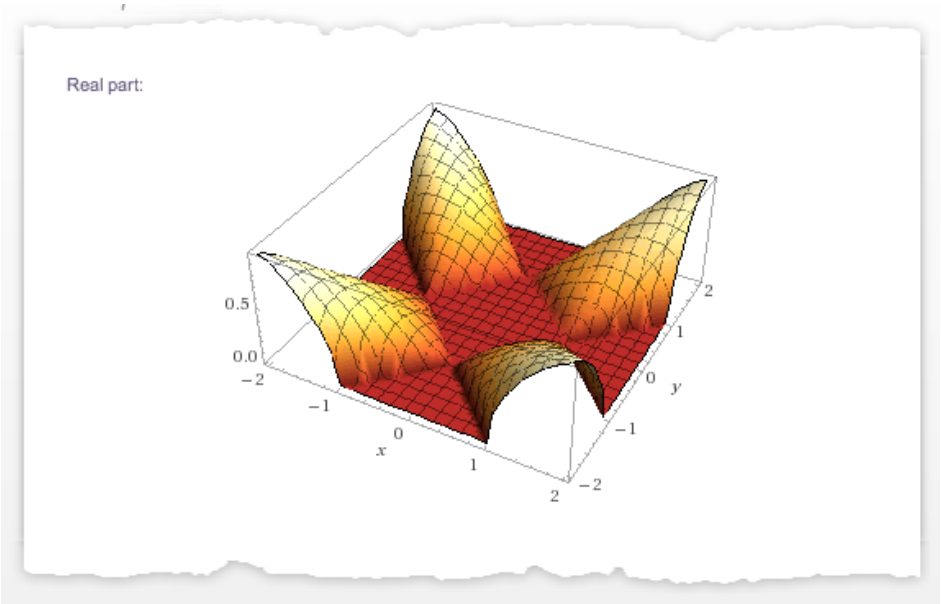
$$S = \sqrt{\frac{a+b+c}{2}\frac{b+c-a}{2}\frac{a+c-b}{2}\frac{a+b-c}{2}} = \sqrt{p(p-a)(p-b)(p-c)} \in \mathcal{R}$$

$$s : \mathcal{R} \times \mathcal{R} \times \mathcal{R} \to \mathcal{R}$$

$$s(a, b, c) = \sqrt{p(p-a)(p-b)(p-c)}$$

Съответната функция

$$s : \mathcal{R} \times \mathcal{R} \times \mathcal{R} \to \mathcal{R}$$
$$s(a, b, c) = \sqrt{p(p-a)(p-b)(p-c)}$$



Съответната подпрограма

$$s : \mathcal{R} \times \mathcal{R} \times \mathcal{R} \to \mathcal{R}$$
$$s(a, b, c) = \sqrt{p(p-a)(p-b)(p-c)}$$

```
double triangleSurface (double a, double b, double c)


{
  double p = (a+b+c)/2;
  double surface = sqrt (p*(p-a)*(p-b)*(p-c));

  return surface;
}
```

Съответната подпрограма

$$s : \mathcal{R} \times \mathcal{R} \times \mathcal{R} \to \mathcal{R}$$
$$s(a, b, c) = \sqrt{p(p-a)(p-b)(p-c)}$$

```
double triangleSurface (double a, double b, double c)

{
  double p = (a+b+c)/2;
  double surface = sqrt (p*(p-a)*(p-b)*(p-c));

  return surface;
}
```

Съответната подпрограма

$$s : \mathcal{R} \times \mathcal{R} \times \mathcal{R} \to \mathcal{R}$$
$$s(a, b, c) = \sqrt{p(p-a)(p-b)(p-c)}$$

```
double triangleSurface (double a, double b, double c)


{
  double p = (a+b+c)/2;
  double surface = sqrt (p*(p-a)*(p-b)*(p-c));

  return surface;
}
```

Програма - потребител

```
int main ()
{

  double a,b,c,a1,b1,c1;

  cout << "Sides␣of␣ABC:";
  cin >> a >> b >> c;
  cout << "Sides␣of␣DEF:"
  cin >> a1 >> b1 >> c1;

  if (triangleSurface(a,b,c) < triangleSurface (a1,b1,c1))
  {
    cout << "Yes,␣ABC␣takes␣less␣space!" << endl;
  } else {
    cout << "No,␣ABC␣does␣not␣take␣less␣space!" << endl;
  }

  return 0;
}
```

Вградени числови функции функции

```
#include <cmath>
```

- abs(x), fabs(x)
- sin(x), cos(x), tan(x), asin(x), acos(x), atan(x) exp(x), log(x), log10(x)
- ceil(x), floor(x)
- sqrt(x), pow(x, n)

Вградени числови функции функции

```
#include <cmath>
```

- abs(x), fabs(x)
- sin(x), cos(x), tan(x), asin(x), acos(x), atan(x) exp(x), log(x), log10(x)
- ceil(x), floor(x)
- sqrt(x), pow(x, n)

Съвсем малко теория

Формални граматики

```
the cat meows.
the dog barks at the cat.
the student lies to the teacher.
```

- Азбука: $\Sigma = \{a..z\}$
- Нетерминални символи: $\{\textbf{Verb}, \textbf{Object}, \textbf{Subject}, \textbf{Prep}, \textbf{Sentence}\}$
- Продукционни правила:

$\textbf{Object} \rightarrow \textit{cat}|\textit{dog}|\textit{student}$
$\textbf{Subject} \rightarrow \textit{cat}|\textit{dog}|\textit{teacher}$
$\textbf{Verb} \rightarrow \textit{meows}|\textit{barks}|\textit{lies}$
$\textbf{Prep} \rightarrow \textit{to}|\textit{at}$
$\textbf{Sentence} \rightarrow \textit{the}\ \ \textbf{Object}\ \ \textbf{Verb}$
$\textbf{Sentence} \rightarrow \textit{the}\ \ \textbf{Object}\ \ \textbf{Verb}\ \ \textbf{Prep}\ \ \textit{the}\ \ \textbf{Subject}$

Формални граматики

```
the cat meows.
the dog barks at the cat.
the student lies to the teacher.
```

- Азбука: $\Sigma = \{a..z\}$
- Нетерминални символи: $\{\textbf{Verb}, \textbf{Object}, \textbf{Subject}, \textbf{Prep}, \textbf{Sentence}\}$
- Продукционни правила:

$\textbf{Object} \rightarrow \textit{cat} | \textit{dog} | \textit{student}$
$\textbf{Subject} \rightarrow \textit{cat} | \textit{dog} | \textit{teacher}$
$\textbf{Verb} \rightarrow \textit{meows} | \textit{barks} | \textit{lies}$
$\textbf{Prep} \rightarrow \textit{to} | \textit{at}$
$\textbf{Sentence} \rightarrow \textit{the}\ \ \textbf{Object}\ \ \textbf{Verb}$
$\textbf{Sentence} \rightarrow \textit{the}\ \ \textbf{Object}\ \ \textbf{Verb}\ \ \textbf{Prep}\ \ \textit{the}\ \ \textbf{Subject}$

Формални граматики

```
the cat meows.
the dog barks at the cat.
the student lies to the teacher.
```

- Азбука: $\Sigma = \{a..z\}$
- Нетерминални символи: $\{\textbf{Verb}, \textbf{Object}, \textbf{Subject}, \textbf{Prep}, \textbf{Sentence}\}$
- Продукционни правила:

Object $\rightarrow$ *cat*|*dog*|*student*
Subject $\rightarrow$ *cat*|*dog*|*teacher*
Verb $\rightarrow$ *meows*|*barks*|*lies*
Prep $\rightarrow$ *to*|*at*
Sentence $\rightarrow$ *the* **Object** **Verb**
Sentence $\rightarrow$ *the* **Object** **Verb** **Prep** *the* **Subject**

Извод на the cat meows at the dog

Object $\rightarrow$ *cat*|*dog*|*student*
Subject $\rightarrow$ *cat*|*teacher*
Verb $\rightarrow$ *meows*|*barks*|*lies*
Prep $\rightarrow$ *to*|*at*
Sentence $\rightarrow$ *the* **Object** **Verb**
Sentence $\rightarrow$ *the* **Object** **Verb** **Prep** *the* **Subject**

Sentence $\rightarrow$ *the* **Object** **Verb** **Prep** *the* **Subject**

Object $\rightarrow$ *cat*

Sentence $\rightarrow$ *the cat* **Verb** **Prep** *the* **Subject**

Verb $\rightarrow$ *meows*

Sentence $\rightarrow$ *the cat meows* **Prep** *the* **Subject**

Prep $\rightarrow$ *at*

Sentence $\rightarrow$ *the cat meows at the* **Subject**

Subject $\rightarrow$ *dog*

Sentence $\rightarrow$ *the cat meows at the dog*

Извод на the cat meows at the dog

Object → *cat*|*dog*|*student*
Subject → *cat*|*teacher*
Verb → *meows*|*barks*|*lies*
Prep → *to*|*at*
Sentence → *the* **Object** **Verb**
Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Object → *cat*

Sentence → *the* *cat* **Verb** **Prep** *the* **Subject**

Verb → *meows*

Sentence → *the* *cat* *meows* **Prep** *the* **Subject**

Prep → *at*

Sentence → *the* *cat* *meows* *at* *the* **Subject**

Subject → *dog*

Sentence → *the* *cat* *meows* *at* *the* *dog*

Извод на the cat meows at the dog

Object → *cat*|*dog*|*student*
Subject → *cat*|*teacher*
Verb → *meows*|*barks*|*lies*
Prep → *to*|*at*
Sentence → *the* **Object** **Verb**
Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Object → *cat*

Sentence → *the* *cat* **Verb** **Prep** *the* **Subject**

Verb → *meows*

Sentence → *the* *cat* *meows* **Prep** *the* **Subject**

Prep → *at*

Sentence → *the* *cat* *meows* *at* *the* **Subject**

Subject → *dog*

Sentence → *the* *cat* *meows* *at* *the* *dog*

Извод на the cat meows at the dog

Object → *cat*|*dog*|*student*
Subject → *cat*|*teacher*
Verb → *meows*|*barks*|*lies*
Prep → *to*|*at*
Sentence → *the* **Object** **Verb**
Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Object → *cat*

Sentence → *the* *cat* **Verb** **Prep** *the* **Subject**

Verb → *meows*

Sentence → *the* *cat* *meows* **Prep** *the* **Subject**

Prep → *at*

Sentence → *the* *cat* *meows* *at* *the* **Subject**

Subject → *dog*

Sentence → *the* *cat* *meows* *at* *the* *dog*

Извод на the cat meows at the dog

Object → *cat*|*dog*|*student*
Subject → *cat*|*teacher*
Verb → *meows*|*barks*|*lies*
Prep → *to*|*at*
Sentence → *the* **Object** **Verb**
Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Object → *cat*

Sentence → *the* *cat* **Verb** **Prep** *the* **Subject**

Verb → *meows*

Sentence → *the* *cat* *meows* **Prep** *the* **Subject**

Prep → *at*

Sentence → *the* *cat* *meows* *at* *the* **Subject**

Subject → *dog*

Sentence → *the* *cat* *meows* *at* *the* *dog*

Извод на the cat meows at the dog

Object → *cat*|*dog*|*student*
Subject → *cat*|*teacher*
Verb → *meows*|*barks*|*lies*
Prep → *to*|*at*
Sentence → *the* **Object** **Verb**
Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Sentence → *the* **Object** **Verb** **Prep** *the* **Subject**

Object → *cat*

Sentence → *the* *cat* **Verb** **Prep** *the* **Subject**

Verb → *meows*

Sentence → *the* *cat* *meows* **Prep** *the* **Subject**

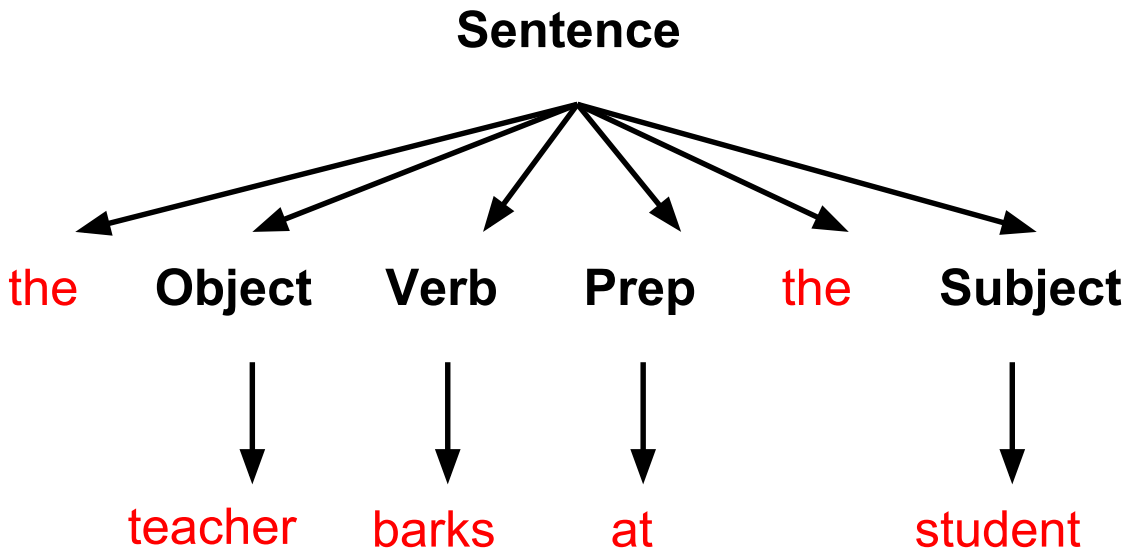
Prep → *at*

Sentence → *the* *cat* *meows* *at* *the* **Subject**

Subject → *dog*

Sentence → *the* *cat* *meows* *at* *the* *dog*

Синтактично дърво



Мета-език на Бекус-Наур

- $< digit >::= 0|1|2|3|4|5|6|7|8|9$
- $< unsignedint >::=< digit >^{+}$
- $< integer >::= [+|-] < unsignedint >$
- $< identifier >::= \_(< letter > | < digit > |\_)^{*}$
- $< identifier >::=< leter > (< letter > | < digit > |\_)^{*}$