- breakpoint en mode debug.

RUN / Start Debugging

passer l'affichage en mode debug

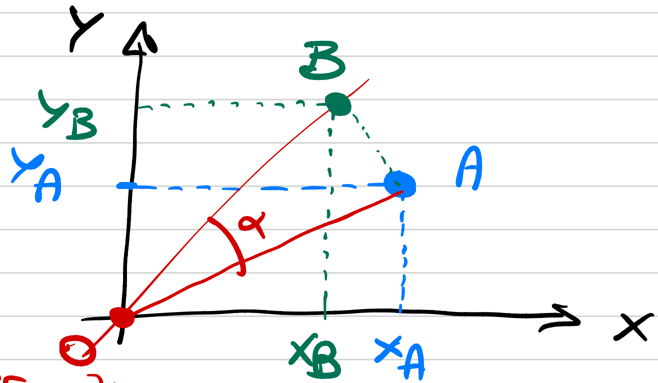
```c
printf("argc=%d\n", argc);
for (k = 0; k < argc; k++)
{
  printf("argv[%d]=%s\n", k, argv[k]);
Expression    k==3
}
```

point d'arrêt conditionnel sur k==3

Callstack

TD 20201207 — Rotation

utilisation d'une matrice 2D
pour calculer les coordonnées d'un point
après rotation.



Centre de rotation

rotation d'un angle α

const. { x_A, y_A, α } → **main**

Calculer et afficher
x_B et y_B
{ %+.3lf

x_A

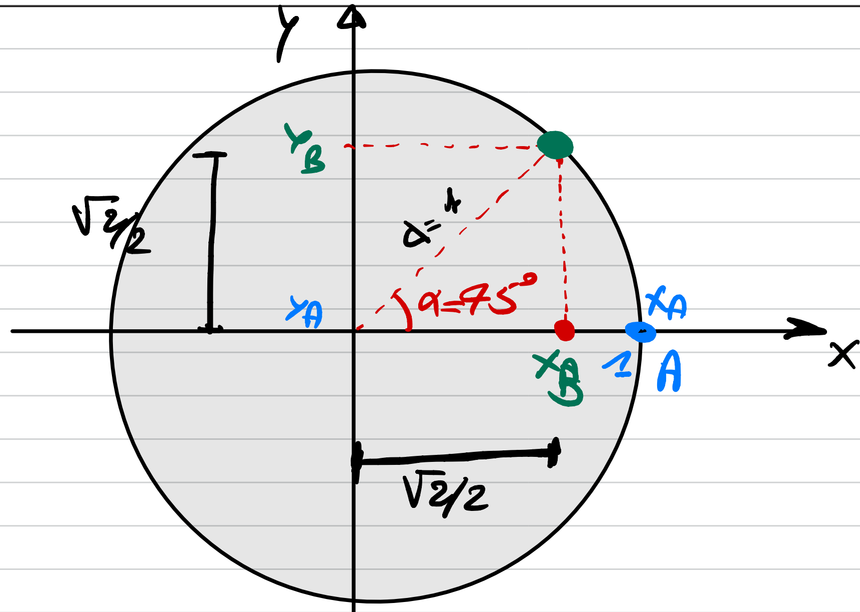
y_A

$x_B = x_A \cos\alpha + y_A(-\sin\alpha)$

$y_B = x_B \sin\alpha + y_B \cos\alpha$

AN: $x_A = 1.$ $\cancel{y_A} = 0.$ $\alpha = 45°$

$45°$



$x_B = y_B = \sqrt{2}/2 = 0.707$

$$\begin{pmatrix} x_B \\ y_B \end{pmatrix} = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix} \cdot \begin{pmatrix} x_A \\ y_A \end{pmatrix}$$

$$B = M \cdot A$$

$B = \begin{bmatrix} x_B \\ y_B \end{bmatrix}$ — 2 lignes, 1 colonne

$A = \begin{bmatrix} x_A \\ y_A \end{bmatrix}$ → dimension : 2 lignes, 1 colonne

$M = \begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix}$ — 2 lignes, 2 colonnes

Ajoutés cas 3 variables

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① créer A sous la forme d'un tableau de 2 lignes et 1 colonne

② — B — 2 lignes et 1 colonne

③ — C — 2 lignes et 2 colonnes

initialisation à 0.

```
double A[2][1] = {
    {0,0},
    {0,0},
};
```

```
double A[2] = {
    0, 0
};
```

double A[2][1] = {
{ 0., },
{ 0. },
};

double A[2] = {
0., 0.
}

double B[2] = { 0. , 0. }

double M [2][2] = {
{ 0., 0. },
{ 0., 0. } };

\# lignes

\# colonnes

1ère ligne

2nd ligne

Remplir les éléments A et M avec les "vraies" valeurs

(x_A y_A cos(α) sin(α) ...).

3)

```c
#define M 2
#define N 2
```

```c
double a[M] = {0,0};
double b[M] = {0,0};
double m[M][N] = {
    {0,0},
    {0,0}
};
```

```c
a[0] = xa;
a[1] = ya;
m[0][0] = cos(alpha_rad);  // ligne 1, col 1
m[0][1] = -sin(alpha_rad); // ligne 1, col 2
m[1][0] = sin(alpha_rad);  // ligne 2, col 1
m[1][1] = cos(alpha_rad);  // ligne 2, col 2
```

If $\mathbf{A}$ is an $m \times n$ matrix and $\mathbf{B}$ is an $n \times p$ matrix,

2×2

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1p} \\ b_{21} & b_{22} & \cdots & b_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{np} \end{pmatrix}$$

2×1

the *matrix product* $\mathbf{C} = \mathbf{AB}$ (denoted without multiplication signs or dots) is defined to be the $m \times p$ matrix[6][7][8][9]

$$\mathbf{C} = \begin{pmatrix} c_{11} & c_{12} & \cdots & c_{1p} \\ c_{21} & c_{22} & \cdots & c_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ c_{m1} & c_{m2} & \cdots & c_{mp} \end{pmatrix}$$

2×1

$(C) = [A][B]$

such that

$$\boxed{c_{ij} = a_{i1}b_{1j} + a_{i2}b_{2j} + \cdots + a_{in}b_{nj} = \sum_{k=1}^{n} a_{ik}b_{kj},}$$

for $i = 1, ..., m$ and $j = 1, ..., p$.

ligne i, colonne j

$c_{ij} = \boxed{\sum_{k=1}^{n}} a_{ik} \cdot b_{kj}$

for (k=0; k<N; k++

If **A** is an $m \times n$ matrix and **B** is an $n \times p$ matrix,

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix}, \quad \mathbf{B} = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1p} \\ b_{21} & b_{22} & \cdots & b_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{np} \end{pmatrix}$$

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such that

$$\boxed{c_{ij} = a_{i1}b_{1j} + a_{i2}b_{2j} + \cdots + a_{in}b_{nj} = \sum_{k=1}^{n} a_{ik}b_{kj},}$$

for $i = 1, \ldots, m$ and $j = 1, \ldots, p$.

$$B = M \cdot A$$

$$\begin{bmatrix} x_B \\ y_B \end{bmatrix} = \begin{bmatrix} \cdot & \cdot \\ \cdot & \cdot \end{bmatrix} \begin{bmatrix} x_A \\ y_A \end{bmatrix}$$

$$\begin{bmatrix} B[0] \\ B[1] \end{bmatrix} = \begin{bmatrix} M[0][0] & M[0][1] \\ M[1][0] & M[1][1] \end{bmatrix} \begin{pmatrix} A[0] \\ A[1] \end{pmatrix}$$

$$B[0] = M[0][0] \cdot A[0] + M[0][1] \cdot A[1]$$

$$B[1] = M[1][0] \cdot A[0] + M[1][1] \cdot A[1]$$

boucle sur les lignes 'i'

$i = [0 .. M[$

#lignes

$k : [0 .. N[$

2 boucles imbriquées.

```
for (i=0 ....      {
    for (k=0 ....  {
        ≡ calcul de B[i]
    }
}.
```