# Chapitre 13

## Structures de données dynamiques : les listes chaînées

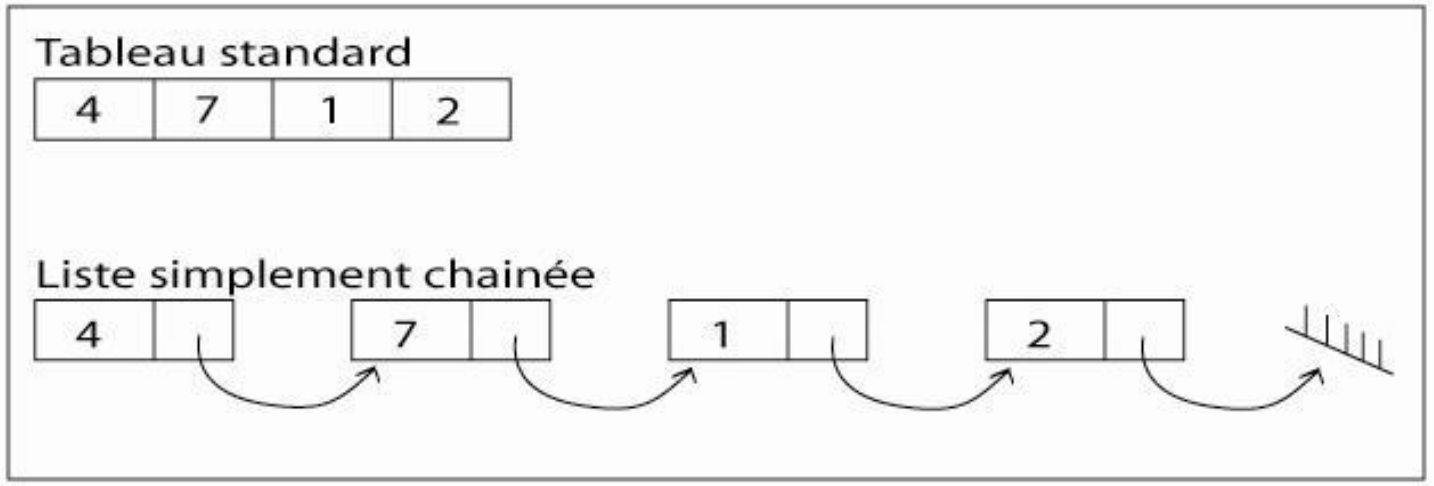
# Listes chaînées

## Problème

Données dont on ne connait **pas la taille**.

Données dont la **quantité et l'organisation varient** dans le temps.

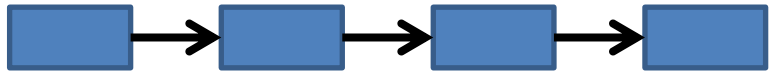
## Solution : les structures dynamiques.



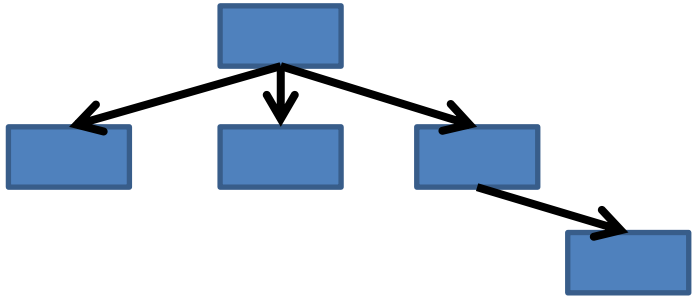
# Listes chaînées

## Structures dynamiques

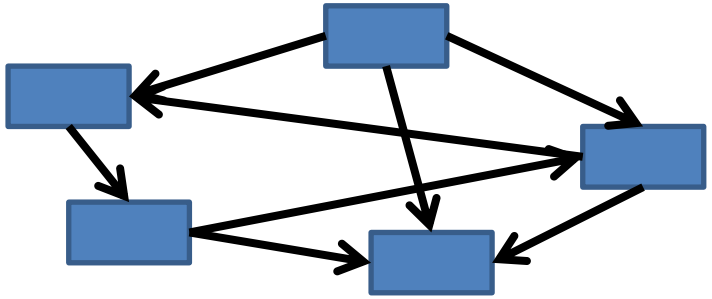
Listes



Arbres

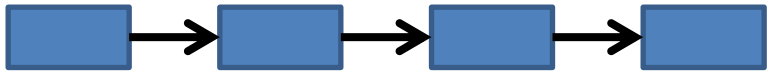


Graphes

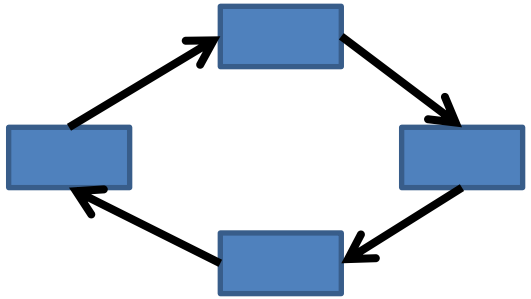


# Listes chaînées

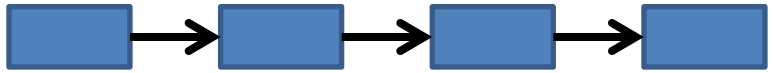
Liste linéaire



Liste circulaire



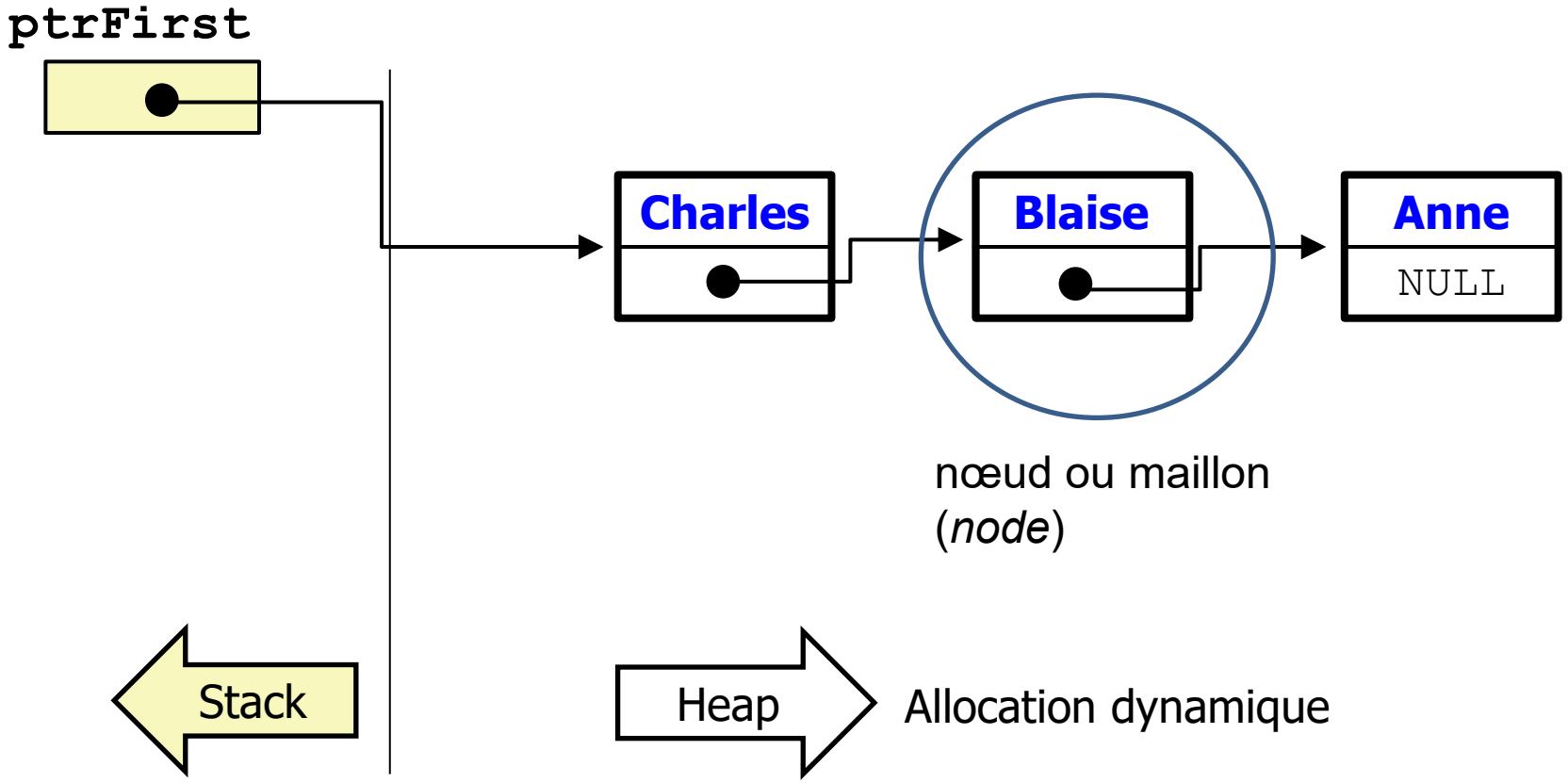
Liste simplement chainée



Liste doublement chainée

# Listes chaînées : exemple

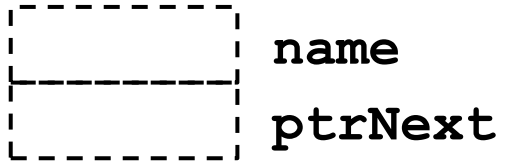
## Liste simplement chaînée contenant des noms



# Listes chaînées : exemple

Déclaration d'une structure `node`

```
struct node
{
    char            name[20];
    struct node *ptrNext;
};
```




Déclaration d'un pointeur

```
struct node *ptrFirst = NULL;
```


Alternative avec `typedef`

```
typedef struct node NodeTy;
NodeTy *ptrFirst = NULL;
```

# Listes chaînées : opérations

## Opérations de base

**Initialisation du pointeur sur le 1er nœud**

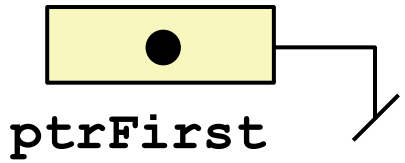
**Ajout d'un nouveau nœud**

- Allocation mémoire d'un nouveau nœud
- Initialisation du nouveau nœud
- Ajout du nouveau nœud au pointeur de liste
- Ajout d'un nouveau nœud en début de chaîne

**Affichage de la liste**

# Listes chaînées : initialisation

**Initialisation** du pointeur sur le premier noeud

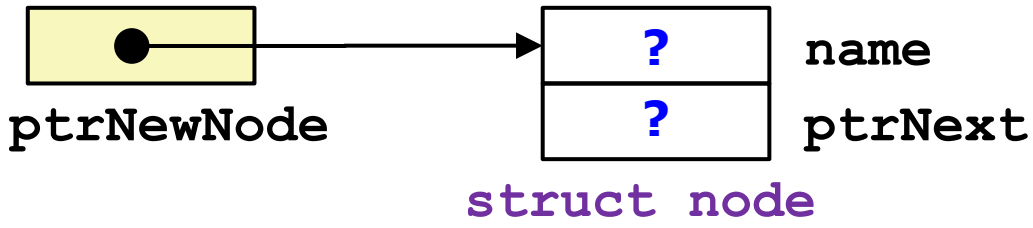



```
ptrFirst = NULL;
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud

1) Allocation en mémoire d'un **nouveau** nœud

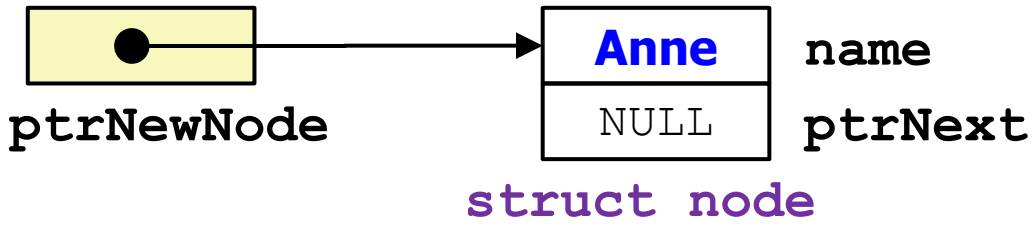



```
struct node* ptrNewNode = malloc(sizeof(struct node));
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

2) Initialisation en mémoire d'un **nouveau** nœud

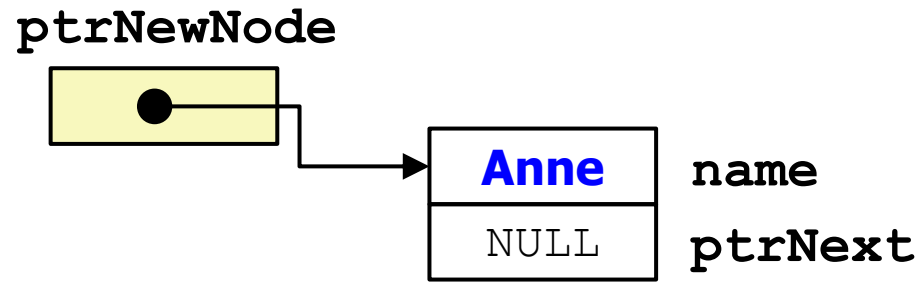



```
gets(ptrNewNode->name);
prtNewNode->ptrNext = NULL;
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

3) Ajout du nouveau nœud au **pointeur de liste**



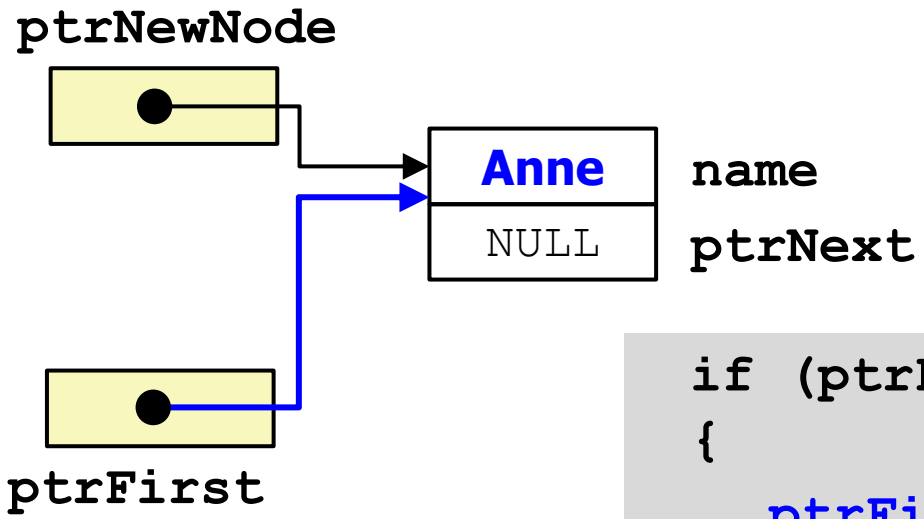


```
if (ptrFirst == NULL)
{


}
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

3) Ajout du nouveau nœud au **pointeur de liste**

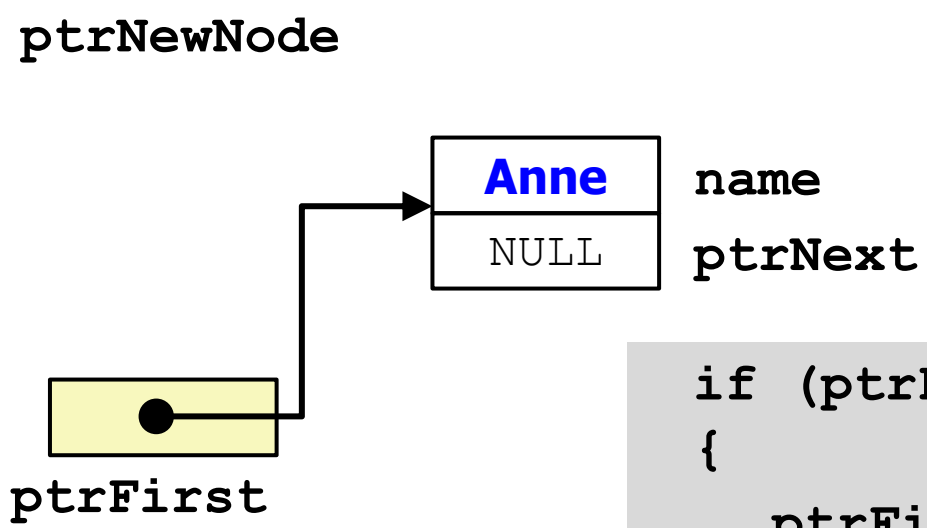



```
if (ptrFirst == NULL)
{
   ptrFirst=ptrNewNode;

}
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

3) Ajout du nouveau nœud au **pointeur de liste**

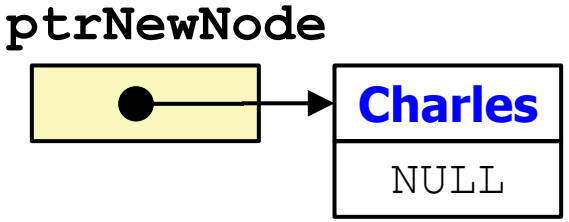



```
if (ptrFirst == NULL)
{
   ptrFirst=ptrNewNode;

}
```

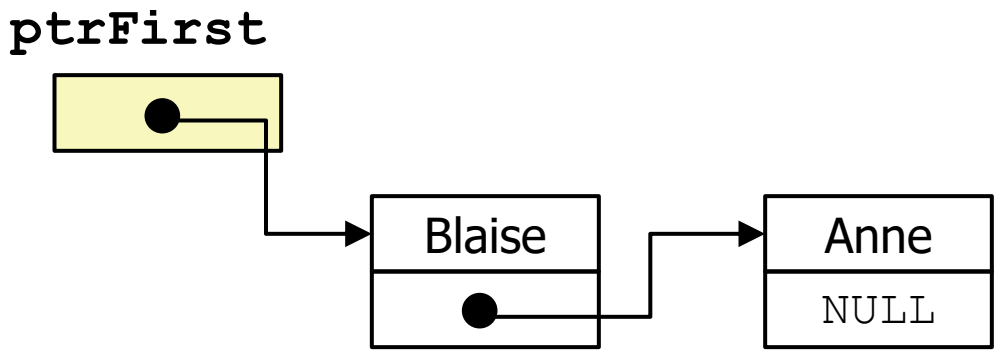
# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

4) Ajout d'un nœud **au début** de chaine



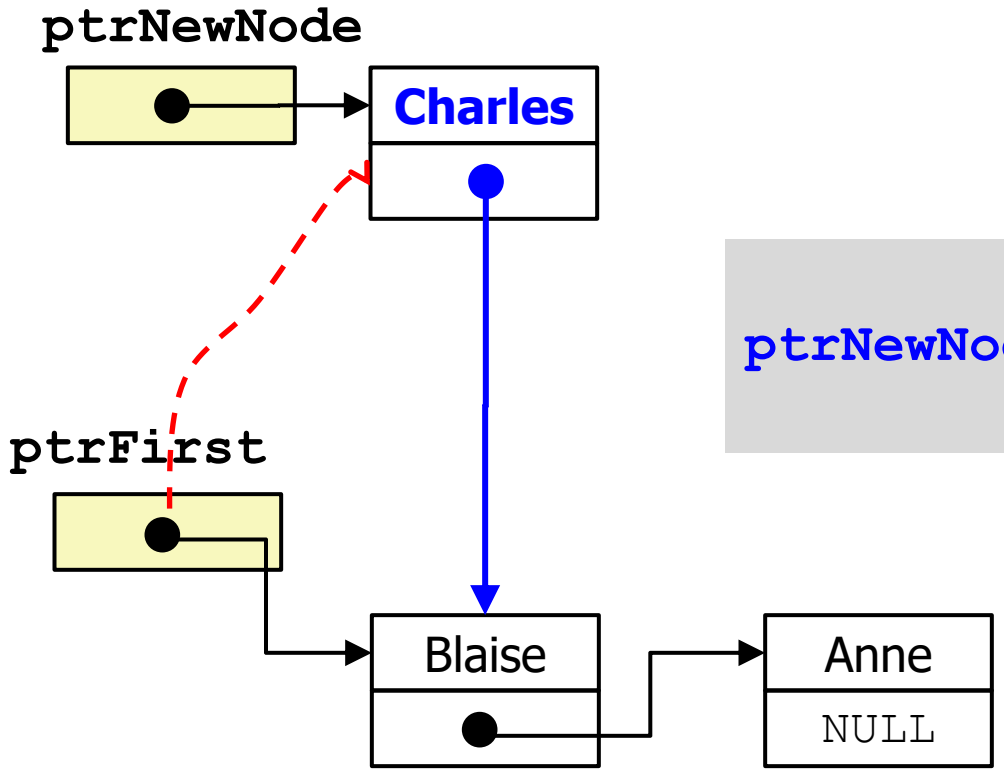

```
if (ptrFirst != NULL)
{


}
```



# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

4) Ajout d'un nœud **au début** de chaine

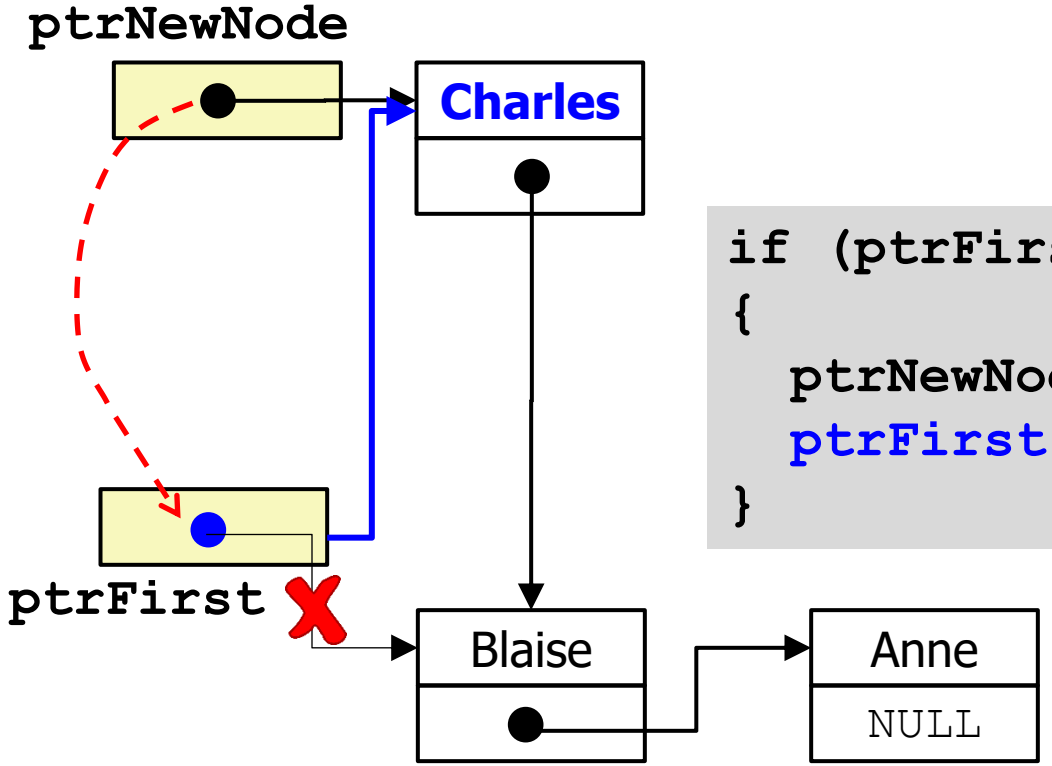



```
ptrNewNode->ptrNext = ptrFirst;
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

4) Ajout d'un nœud **au début** de chaine

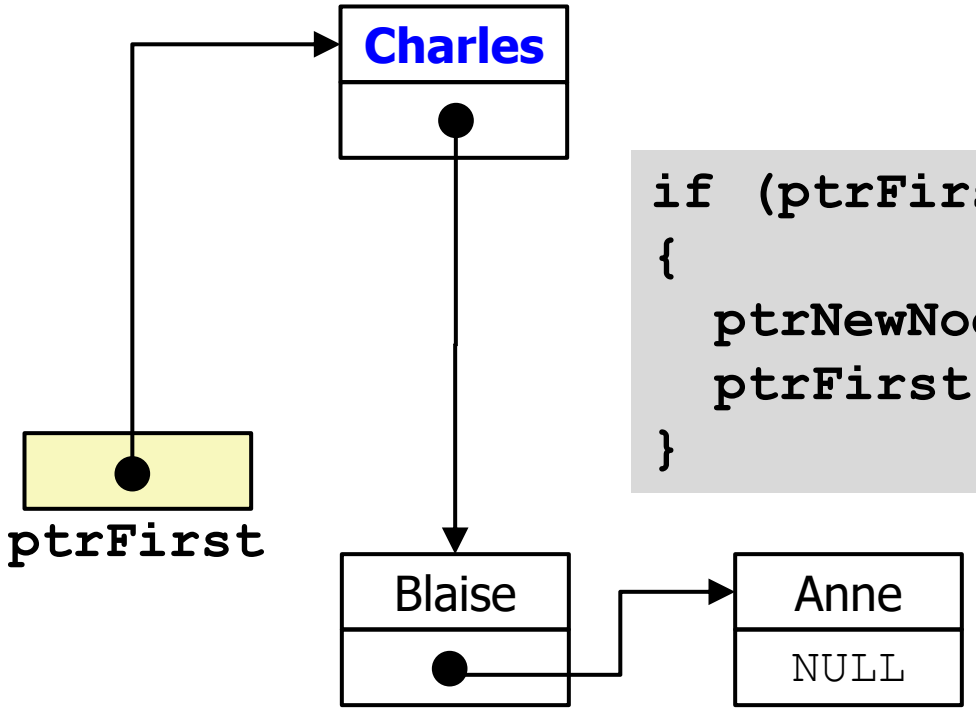



```
if (ptrFirst != NULL)
{
  ptrNewNode->ptrNext = ptrFirst;
  ptrFirst = ptrNewNode;
}
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

4) Ajout d'un nœud **au début** de chaine




```
if (ptrFirst != NULL)
{
  ptrNewNode->ptrNext = ptrFirst;
  ptrFirst = ptrNewNode;
}
```

# Listes chaînées : ajout

**Ajout** d'un nouveau nœud (suite)

On peut simplifier :

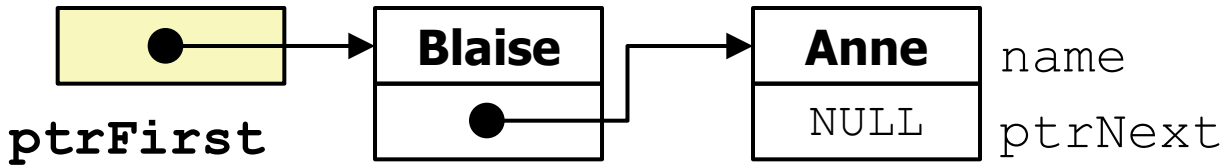
```
ptrNewNode->ptrNext = NULL;
if (ptrFirst == NULL)
   ptrFirst = ptrNewNode;
else
{
   ptrNewNode->ptrnext = ptrFirst;
   ptrFirst            = ptrNewNode;
}
```

Comme ceci :

```
ptrNewNode->ptrNext = ptrFirst;
ptrFirst            = ptrNewNode;
```

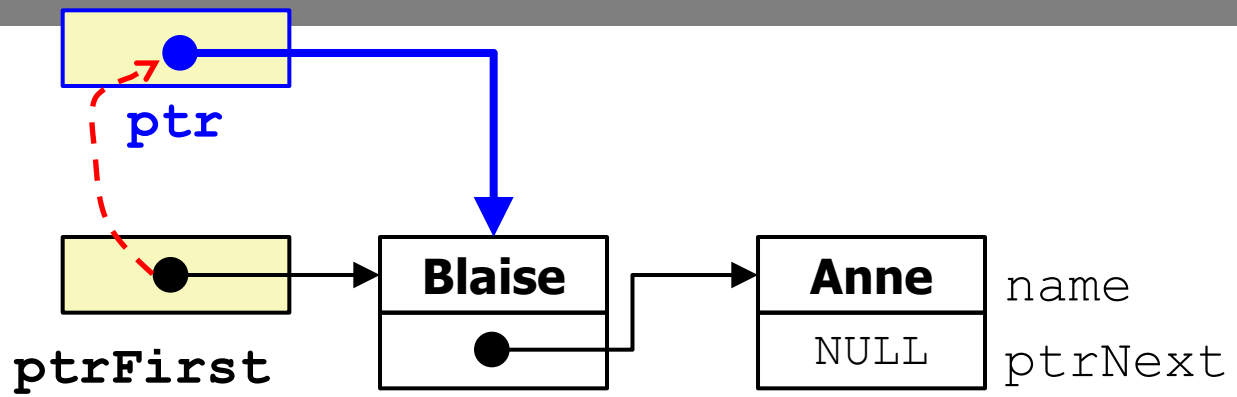
# Listes chaînées : affichage

## Affichage



# Listes chaînées : affichage

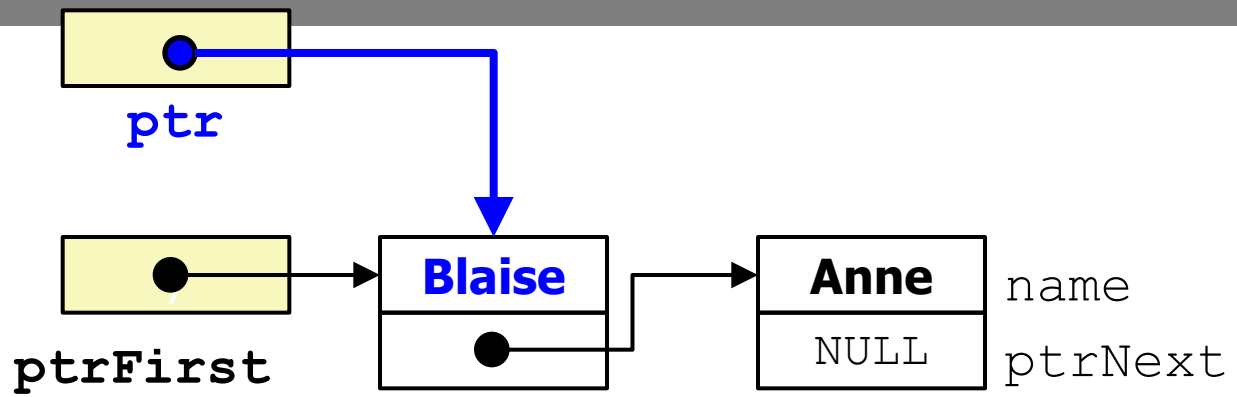
## Affichage




```
struct node* ptr;
ptr = ptrFirst;
while (ptr != NULL)
{
  printf("%s\n", ptr->name);
  ptr = ptr->ptrNext;
}
```

# Listes chaînées : affichage

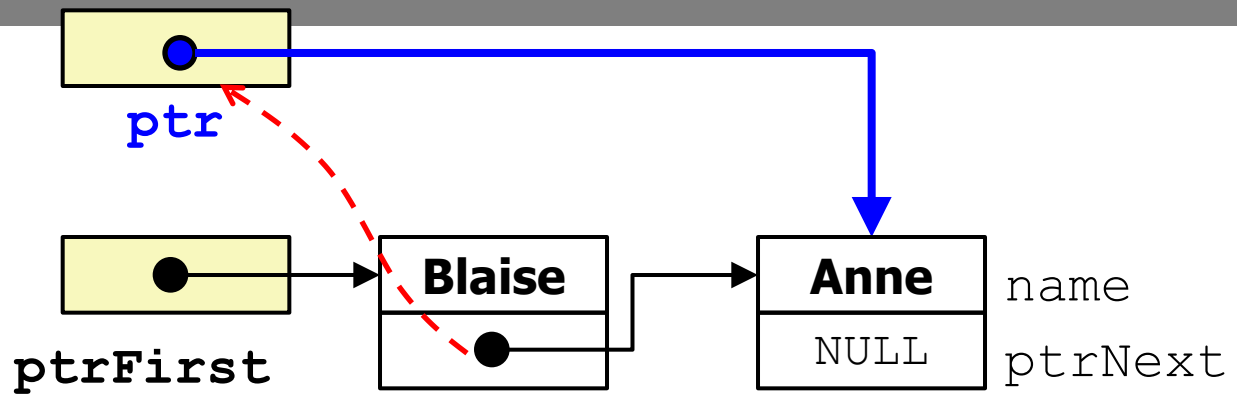
## Affichage




```
struct node* ptr;
ptr = ptrFirst;
while (ptr != NULL) //(true)
{
  printf("%s\n", ptr->name);
  ptr = ptr->ptrNext;
}
```

# Listes chaînées : affichage

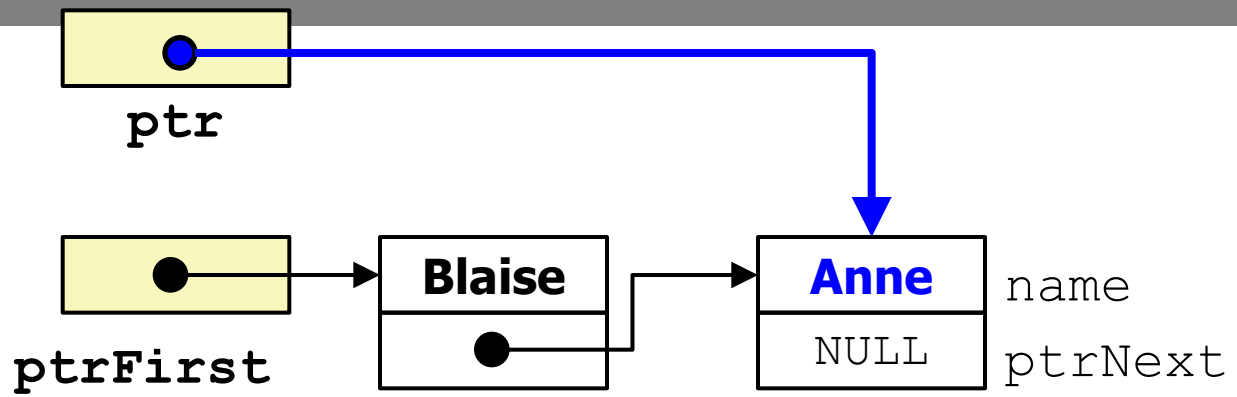
## Affichage




```
struct node* ptr;
ptr = ptrFirst;
while (ptr != NULL)
{
  printf("%s\n", ptr->name);
  ptr = ptr->ptrNext;
}
```

# Listes chaînées : affichage

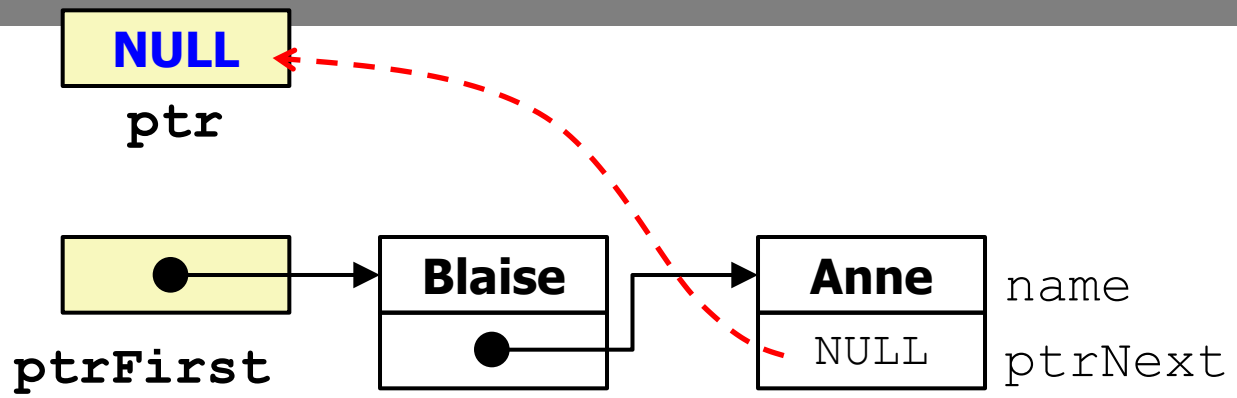
## Affichage




```
struct node* ptr;
ptr = ptrFirst;
while (ptr != NULL) //(true)
{
  printf("%s\n", ptr->name);
  ptr = ptr->ptrNext;
}
```

# Listes chaînées : affichage

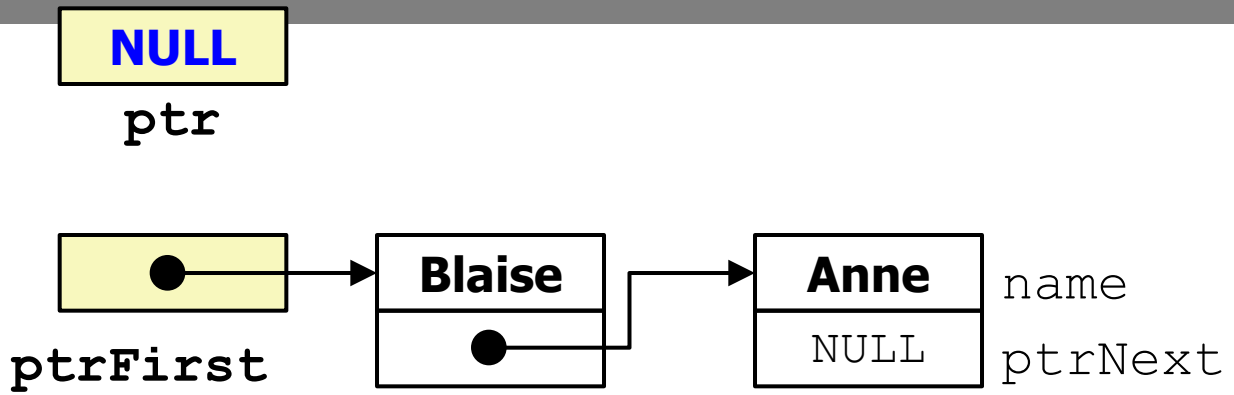
## Affichage




```
struct node* ptr;
ptr = ptrFirst;
while (ptr != NULL)
{
  printf("%s\n", ptr->name);
  ptr = ptr->ptrNext;
}
```

# Listes chaînées : affichage

## Affichage




```
struct node* ptr;
ptr = ptrFirst;
while (ptr != NULL)
{
  printf("%s\n", ptr->name);
  ptr = ptr->ptrNext;
}
```

false

# Listes chaînées : programme (1)

```
#include <stdio.h>

struct node
{
   char name[20];
   struct node* ptrNext;
};

struct node *ptrFirst=NULL;

void addNode(void);
void displayList (void);
```

# Listes chaînées : programme (2)

```
int main(void)
{
   char choice;
   printf("Insert a new name (Y/N)? ");
   scanf(" %c", &choice);
   while (toupper(choice) != 'N')
   {
       addNode();
       printf("Insert a new name (Y/N)? ");
       scanf(" %c", &choice);
   }
   displayList();
   return 0;
}
```

# Listes chaînées : programme (3)

```
void addNode(struct node *ptrFirst)
{
   struct node* ptrNewNode;
   ptrNewNode = malloc(sizeof(struct node));

   printf("Enter a name: ");
   fflush(stdin);
   gets(ptrNewNode->name);

   ptrNewNode->ptrNext = ptrFirst;
   ptrFirst            = ptrNewNode;
}
```

# Listes chaînées : programme (4)

```
void displayList(struct node *ptrFirst)
{
   struct node * ptr;
   ptr = ptrFirst;
   if (ptr == NULL)
        printf("La liste est vide\n");
  else
   {
        printf("\nContenu de la liste: \n");
        while (ptr != NULL)
        {
              printf("%s\n", ptr->name);
              ptr = ptr->ptrNext;
        }
   }
}
```

# Listes chaînées : programme (5)

```
void emptyList (struct node *ptrFirst)
{
   struct node *ptr, *nextPtr;
   ptr = ptrFirst;
   while (ptr != NULL) {
       nextPtr = ptr->ptrNext;          // (1)
       free(ptr);                       // (2)
       ptr = nextPtr;                   // (3)
   }
}

// Remarque : le pointeur sur le nœud suivant
// est pris avant (1) l'appel de la fonction
// free(). Il est possible que l'espace libéré
// puisse être réutilisé avant l'exécution de
// la ligne suivante (3) et que ptrSuivant soit invalide
```

# Exercices

[Exercices du chapitre 13]

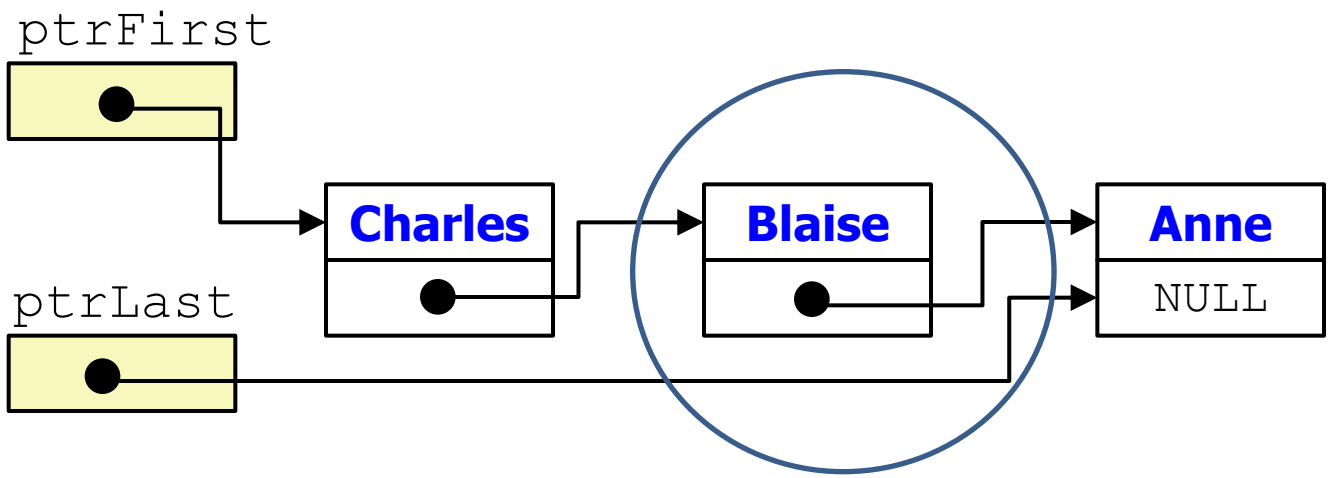
# ANNEXE

## Liste chainées avec deux pointeurs

ptrFirst : pointe sur le premier nœud

ptrLast : pointe sur le dernier nœud

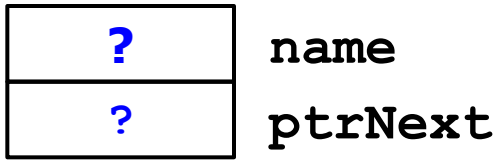
# Exemple Liste simplement chaînée contenant des noms




nœud ou maillon

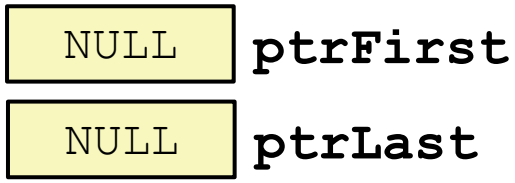
# Déclaration du type noeud:

```
struct node
{
   char           name[20];
   struct node *ptrNext;
};
```




# Déclaration des deux pointeurs :

```
struct node *ptrFirst = NULL,
            *ptrLast = NULL;
```




# Alternative avec `typedef`

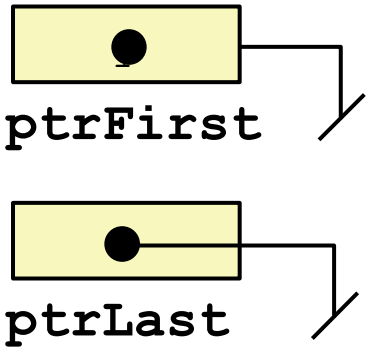
```
typedef struct node NodeTy;
NodeTy *ptrFirst, *ptrLast;
```

**Opérations de base:**

a) Initialisation des pointeurs
b) Ajouter un nœud
    1) Allocation mémoire d'un nouveau nœud
    2) Initialisation du nœud
    3) Ajout du nœud à la liste
        Au début de la liste
        A la fin de la liste
c) Afficher la liste

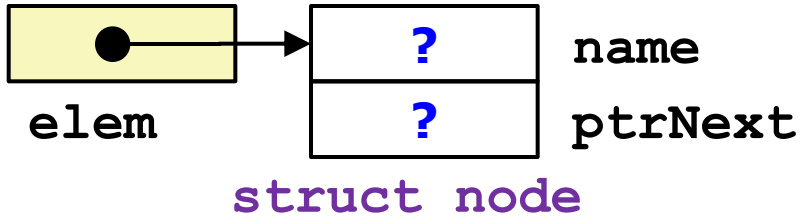
## a) Initialisation des pointeurs

```
ptrFirst = NULL;
ptrLast  = NULL;
```



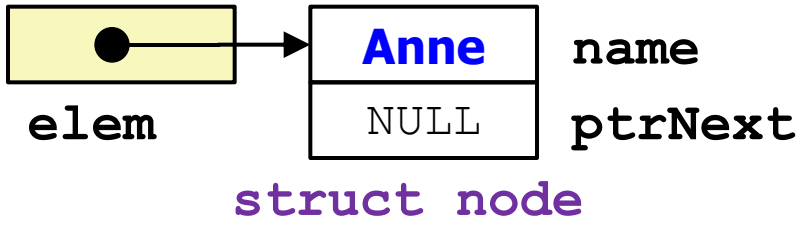
# b) Ajouter un nœud

## 1) Allocation en mémoire d'un nouveau nœud




```
struct node* elem;
elem = malloc(sizeof(struct node));
```

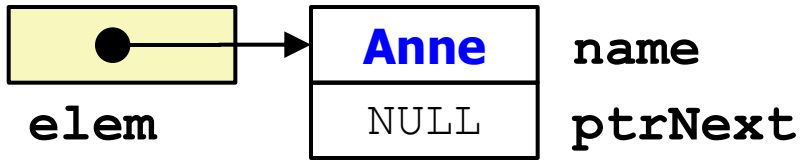
## 2) Initialisation d'un nœud

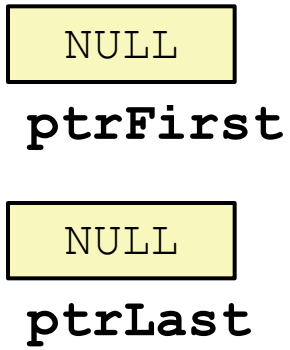



```
gets(elem->name);
elem->ptrNext = NULL;
```

# b) Ajouter un nœud

## 3) Ajout d'un nœud à une liste vide

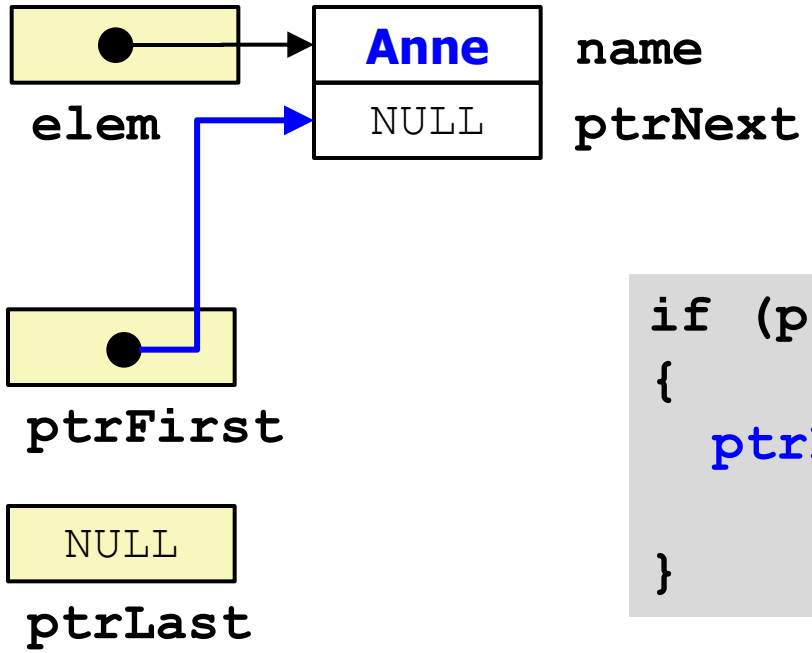



```
if (ptrLast == NULL)
{


}
```

# b) Ajouter un nœud

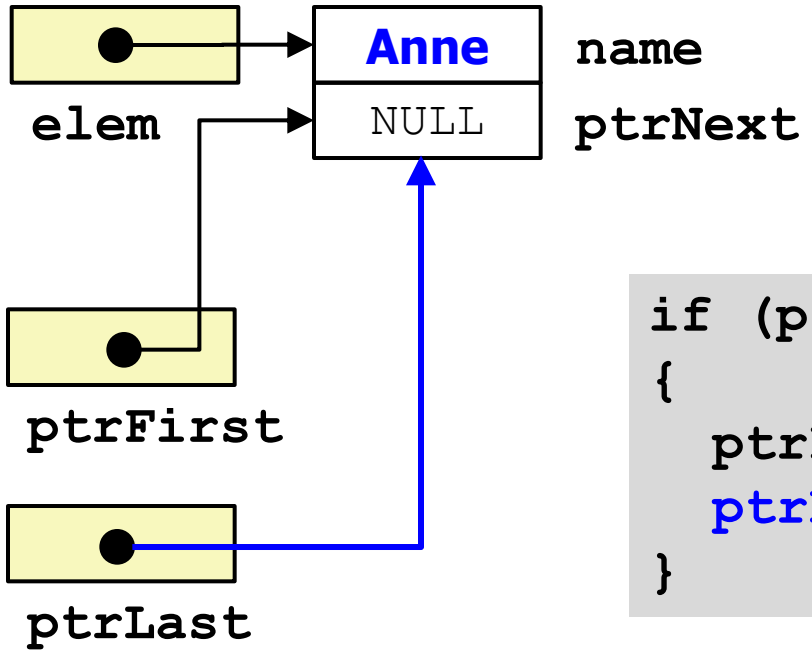
## 3) Ajout d'un nœud à une liste vide




```
if (ptrLast == NULL)
{
  ptrFirst = elem;

}
```

# b) Ajouter un nœud

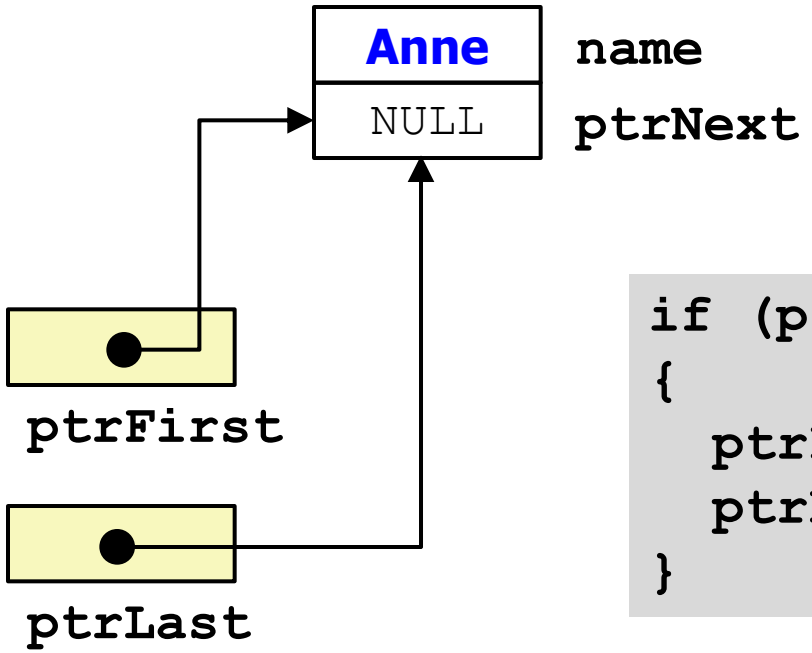
## 3) Ajout d'un nœud à une liste vide




```
if (ptrLast == NULL)
{
  ptrFirst = elem;
  ptrLast = elem;
}
```

# b) Ajouter un nœud

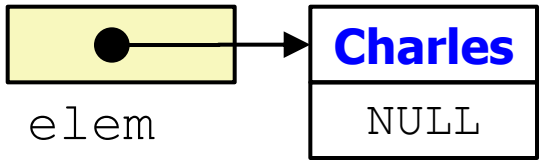
## 3) Ajout d'un nœud à une liste vide



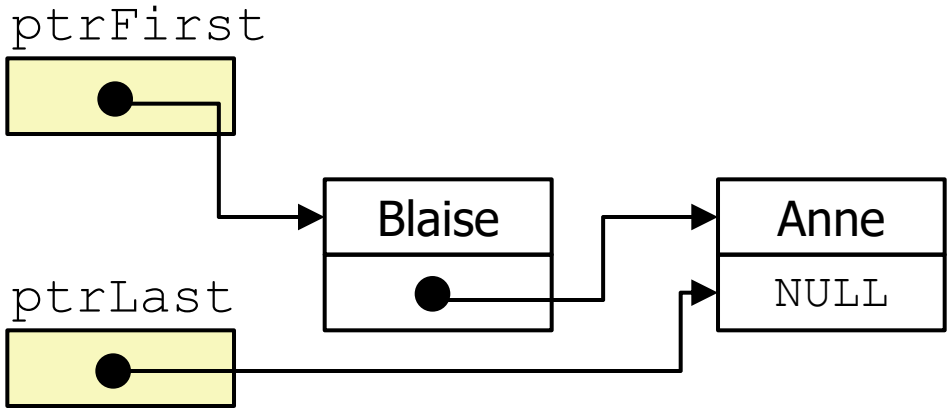

```
if (ptrLast == NULL)
{
  ptrFirst = elem;
  ptrLast = elem;
}
```

# b) Ajouter un nœud

## 3) Ajout d'un nœud **au début** de liste

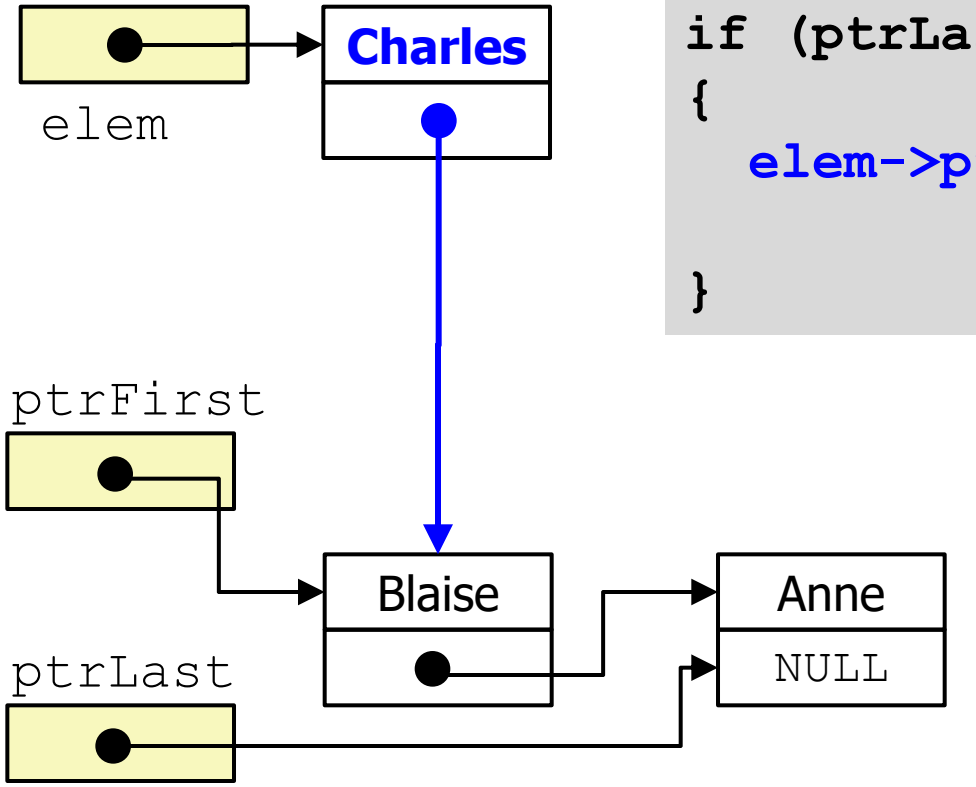



```
if (ptrLast != NULL)
{


}
```



# b) Ajouter un nœud

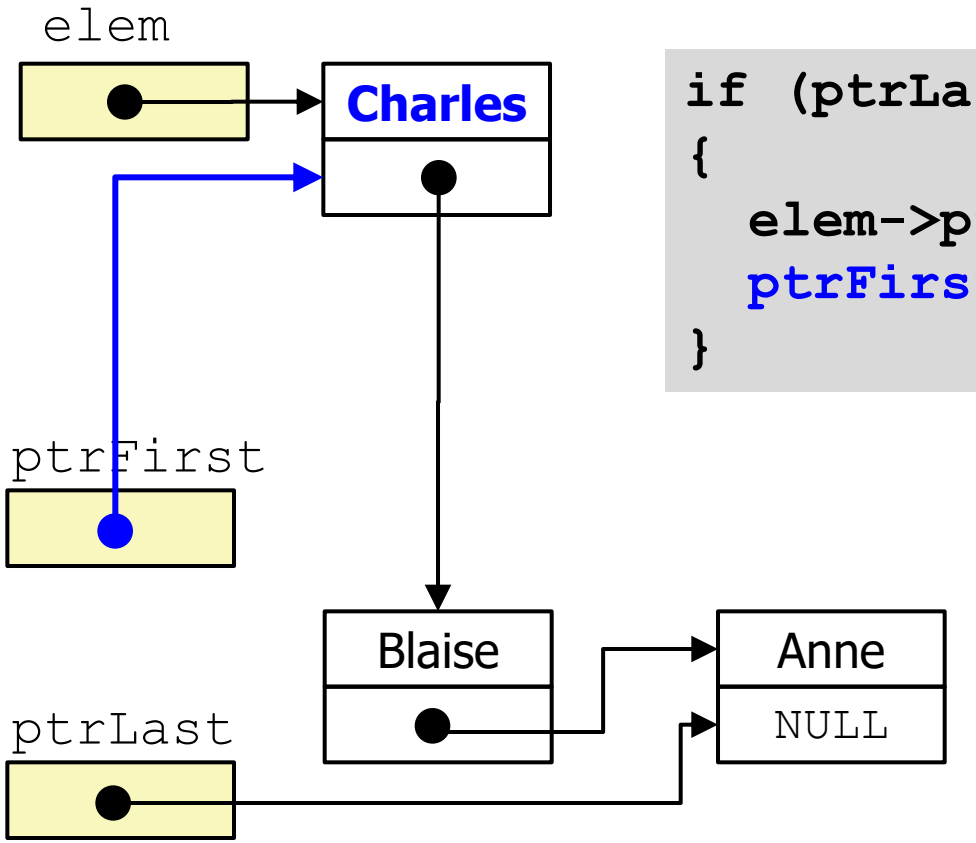
## 3) Ajout d'un nœud **au début** de liste




```
if (ptrLast != NULL)
{
  elem->ptrNext = ptrFirst;

}
```

# b) Ajouter un nœud

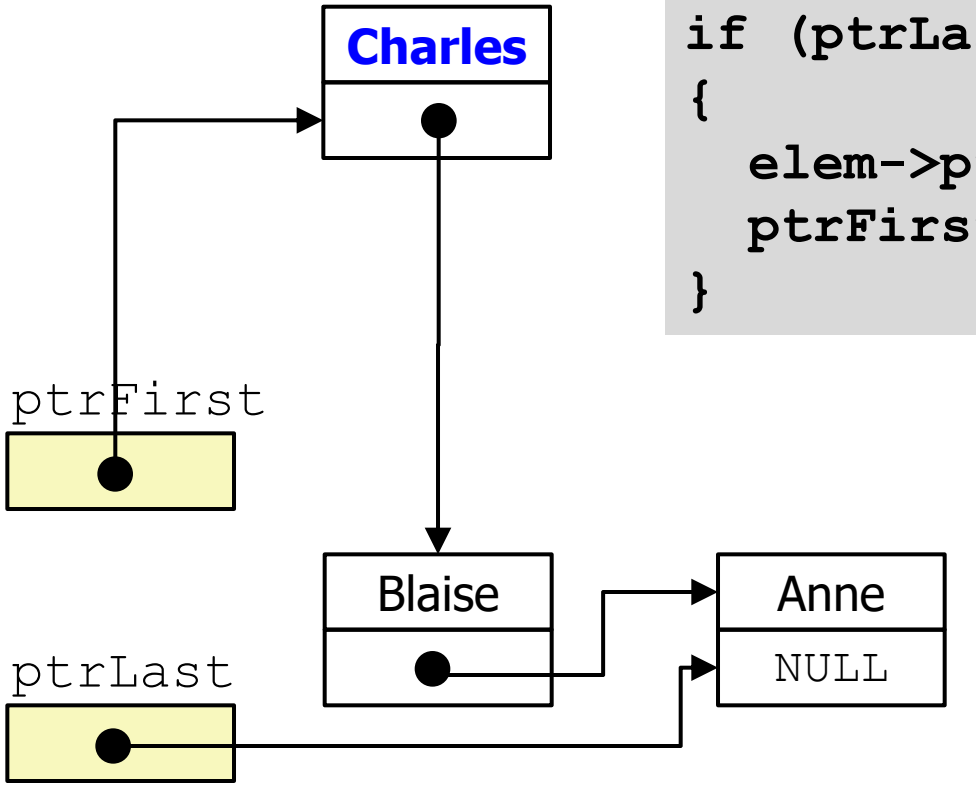
## 3) Ajout d'un nœud **au début** de liste




```
if (ptrLast != NULL)
{
  elem->ptrNext = ptrFirst;
  ptrFirst = elem;
}
```

# b) Ajouter un nœud

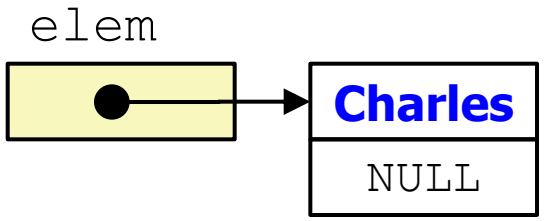
## 3) Ajout d'un nœud **au début** de liste



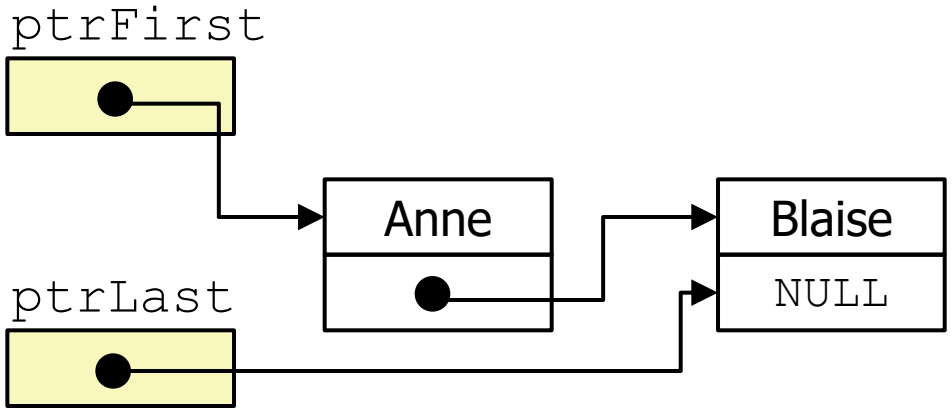

```
if (ptrLast != NULL)
{
  elem->ptrNext = ptrFirst;
  ptrFirst = elem;
}
```

# b) Ajouter un nœud

## 3) Ajout d'un nœud **à la fin** de liste

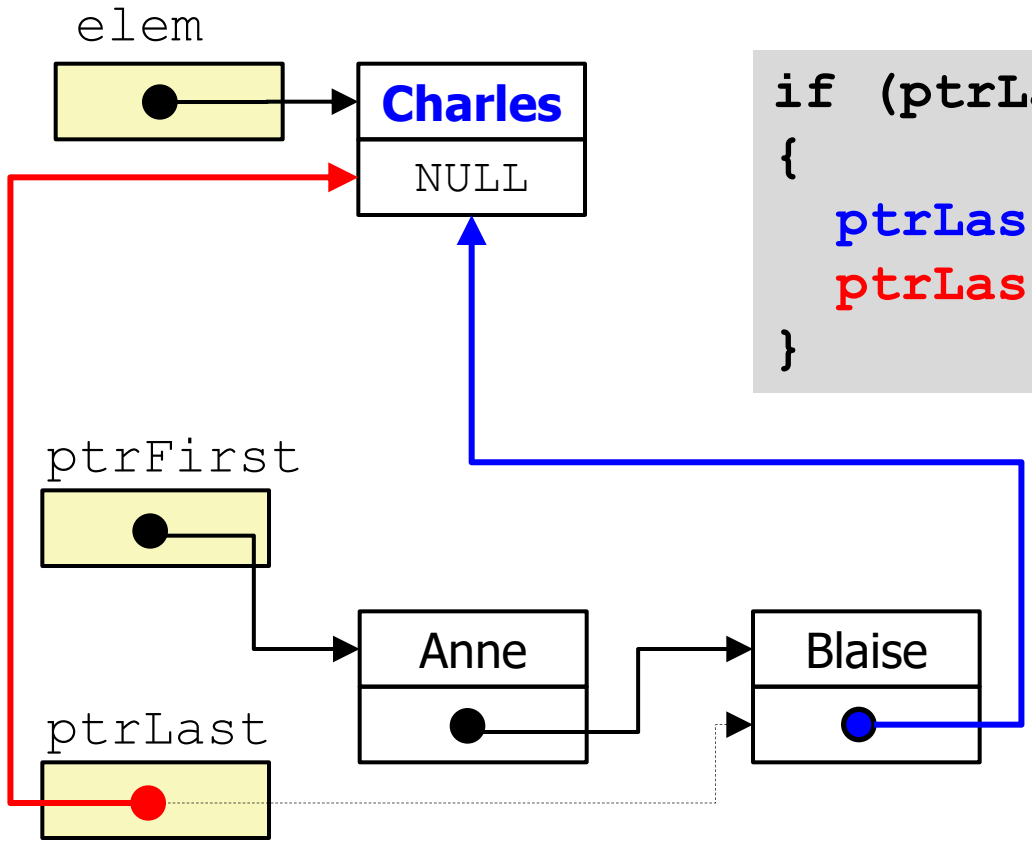



```
if (ptrLast != NULL)
{


}
```



# b) Ajouter un nœud

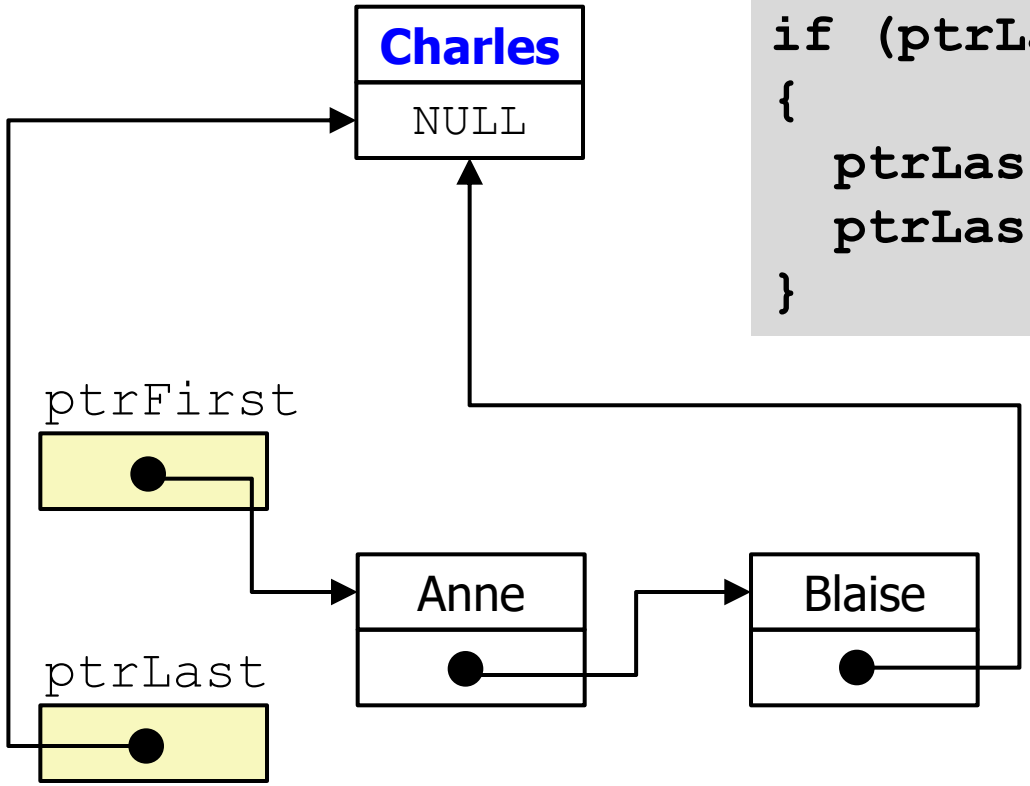
## 3) Ajout d'un nœud **à la fin** de liste




```
if (ptrLast != NULL)
{
  ptrLast->ptrNext = elem;
  ptrLast = elem;
}
```

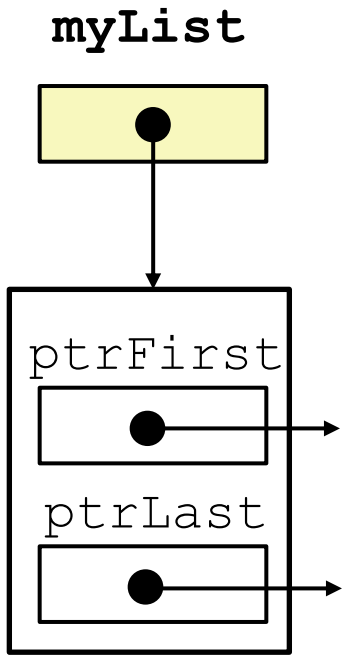
# b) Ajouter un nœud

## 3) Ajout d'un nœud **à la fin** de liste




```
if (ptrLast != NULL)
{
  ptrLast->ptrNext = elem;
  ptrLast = elem;
}
```

# **Bon usage :** définir une structure pour la liste !




```
struct list
{
   struct node *ptrFirst;
   struct node *ptrLast;
};


struct list *myList;
myList = malloc(sizeof(struct list));

AddNode(myList);

//plutôt que AddNode(&ptrFirst,&ptrLast);
```