Lenguajes de Programación - Examen 2

Integrantes

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Ejercicios

1. Evalua la siguiente expresion usando representacion de ambientes en todos los casos:

```
{with {x {+ 3 2}}
  {with {y {+ 1 2}}
    {with {z 7}
      {with {foo {fun{x} {+ x {+ y z}}}}
        {with {x 3}
          {with {y {+ 2 2}}
            {with z {+ 1 1}}
              {with {mas-foo {fun {y} {* 1 {* x y}}}}
                {with {x 2}
                  {with {y 1}
                    {foo 1}}}}}}}}}}
```

   - Evaluacion perezosa y alcance estatico.

     Solución:

Evaluación	Ambiente
`{with {x {+ 3 2}} {with {y {+ 1 2}} {with {z 7} {with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}}}}`	`---------- `
`{with {y {+ 1 2}} {with {z 7} {with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}}}`	`---------- x | {+ 3 2} ----------`
`{with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}}`	`---------- z | 7 ---------- y | {+ 1 2} ---------- x | {+ 3 2} ----------`
`{with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}`	`---------- foo | {fun{x} {+ x {+ y z}}} ---------- z | 7 ---------- y | {+ 1 2} ---------- x | {+ 3 2} ----------`
`{with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}`	`---------- x | 3 ---------- foo | {fun{x} {+ x {+ y z}}} ---------- z | 7 ---------- y | {+ 1 2} ---------- x | {+ 3 2} ----------`

```
{with z {+ 1 1}}
  {with {mas-foo {fun {y} {* 1 {* x y}}}}
    {with {x 2}
      {with {y 1}
        {foo 1}}}}}
```

```
---------------------------
   y   |     {+ 2 2}
---------------------------
   x   |         3
---------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------
   z   |         7
---------------------------
   y   |     {+ 1 2}
---------------------------
   x   |     {+ 3 2}
---------------------------
```

```
{with {mas-foo {fun {y} {* 1 {* x y}}}}
  {with {x 2}
    {with {y 1}
      {foo 1}}}}
```

```
---------------------------
   z   |     {+ 1 1}
---------------------------
   y   |     {+ 2 2}
---------------------------
   x   |         3
---------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------
   z   |         7
---------------------------
   y   |     {+ 1 2}
---------------------------
   x   |     {+ 3 2}
---------------------------
```

```
{with {x 2}
  {with {y 1}
    {foo 1}}}
```

```
---------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------
   z   |     {+ 1 1}
---------------------------
   y   |     {+ 2 2}
---------------------------
   x   |         3
---------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------
   z   |         7
---------------------------
   y   |     {+ 1 2}
---------------------------
   x   |     {+ 3 2}
---------------------------
```

```
{with {y 1}
  {foo 1}}
```

```
---------------------------
   x   |         2
---------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------
   z   |     {+ 1 1}
---------------------------
   y   |     {+ 2 2}
---------------------------
   x   |         3
---------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------
   z   |         7
---------------------------
   y   |     {+ 1 2}
---------------------------
   x   |     {+ 3 2}
---------------------------
```

```
{foo 1}
```

```
---------------------------
   y   |         1
---------------------------
   x   |         2
---------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------
   z   |     {+ 1 1}
---------------------------
   y   |     {+ 2 2}
---------------------------
   x   |         3
---------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------
   z   |         7
---------------------------
   y   |     {+ 1 2}
---------------------------
   x   |     {+ 3 2}
---------------------------
```

```
---------------------------
   y   |         1
---------------------------
   x   |         2
---------------------------
```

```
{{fun{x} {+ x {+ y z}}} 1}
```

```
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
> foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{+ 1 {+ y z}}
```

```
--------------------------------
    y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
> foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{+ 1 {+ {+ 1 2} z}}
```

```
--------------------------------
    y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
>   y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{+ 1 {+ {+ 1 2} 7}}
```

```
--------------------------------
    y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
>   z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{+ 1 {+ 3 7}}
```

```
--------------------------------
    y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
>   z   |        7
```

	`` ----------------------------- y | {+ 1 2} ----------------------------- x | {+ 3 2} ----------------------------- ```
`` {+ 1 10} ```	``` ----------------------------- y | 1 ----------------------------- x | 2 ----------------------------- mas-foo | {fun {y} {* 1 {* x y}}} ----------------------------- z | {+ 1 1} ----------------------------- y | {+ 2 2} ----------------------------- x | 3 ----------------------------- foo | {fun{x} {+ x {+ y z}}} ----------------------------- > z | 7 ----------------------------- y | {+ 1 2} ----------------------------- x | {+ 3 2} ----------------------------- ```
`` 11 ```	``` ----------------------------- y | 1 ----------------------------- x | 2 ----------------------------- mas-foo | {fun {y} {* 1 {* x y}}} ----------------------------- z | {+ 1 1} ----------------------------- y | {+ 2 2} ----------------------------- x | 3 ----------------------------- foo | {fun{x} {+ x {+ y z}}} ----------------------------- > z | 7 ----------------------------- y | {+ 1 2} ----------------------------- x | {+ 3 2} ----------------------------- ```

- Evaluacion perezosa y alcance dinámico.

Solución:

Evaluación	Ambiente
`` {with {x {+ 3 2}} {with {y {+ 1 2}} {with {z 7} {with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}}}} ```	``` ----------------------------- ```
`` {with {y {+ 1 2}} {with {z 7} {with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}}} ```	``` ----------------------------- x | {+ 3 2} ----------------------------- ```
`` {with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}} ```	``` ----------------------------- z | 7 ----------------------------- y | {+ 1 2} ----------------------------- x | {+ 3 2} ----------------------------- ```
`` {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} ```	``` ----------------------------- foo | {fun{x} {+ x {+ y z}}} ----------------------------- z | 7 ----------------------------- y | {+ 1 2} ```

```
          {with {y 1}
            {foo 1}}}}}}}
```

```
-----------------------
   x   |     {+ 3 2}
-----------------------
```

```
{with {y {+ 2 2}}
  {with z {+ 1 1}}
    {with {mas-foo {fun {y} {* 1 {* x y}}}}
      {with {x 2}
        {with {y 1}
          {foo 1}}}}}}
```

```
-----------------------------
   x   |        3
-----------------------------
  foo  | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |        7
-----------------------------
   y   |     {+ 1 2}
-----------------------------
   x   |     {+ 3 2}
-----------------------------
```

```
{with z {+ 1 1}}
  {with {mas-foo {fun {y} {* 1 {* x y}}}}
    {with {x 2}
      {with {y 1}
        {foo 1}}}}}
```

```
-----------------------------
   y   |     {+ 2 2}
-----------------------------
   x   |        3
-----------------------------
  foo  | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |        7
-----------------------------
   y   |     {+ 1 2}
-----------------------------
   x   |     {+ 3 2}
-----------------------------
```

```
{with {mas-foo {fun {y} {* 1 {* x y}}}}
  {with {x 2}
    {with {y 1}
      {foo 1}}}}
```

```
-----------------------------
   z   |     {+ 1 1}
-----------------------------
   y   |     {+ 2 2}
-----------------------------
   x   |        3
-----------------------------
  foo  | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |        7
-----------------------------
   y   |     {+ 1 2}
-----------------------------
   x   |     {+ 3 2}
-----------------------------
```

```
{with {x 2}
  {with {y 1}
    {foo 1}}}
```

```
-----------------------------
mas-foo | {fun {y} {* 1 {* x y}}
-----------------------------
   z   |     {+ 1 1}
-----------------------------
   y   |     {+ 2 2}
-----------------------------
   x   |        3
-----------------------------
  foo  | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |        7
-----------------------------
   y   |     {+ 1 2}
-----------------------------
   x   |     {+ 3 2}
-----------------------------
```

```
{with {y 1}
  {foo 1}}
```

```
-----------------------------
   x   |        2
-----------------------------
mas-foo | {fun {y} {* 1 {* x y}}
-----------------------------
   z   |     {+ 1 1}
-----------------------------
   y   |     {+ 2 2}
-----------------------------
   x   |        3
-----------------------------
  foo  | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |        7
-----------------------------
   y   |     {+ 1 2}
-----------------------------
   x   |     {+ 3 2}
-----------------------------
```

```
{foo 1}
```

```
-----------------------------
   y   |        1
-----------------------------
   x   |        2
-----------------------------
mas-foo | {fun {y} {* 1 {* x y}}
-----------------------------
   z   |     {+ 1 1}
-----------------------------
   y   |     {+ 2 2}
-----------------------------
   x   |        3
```

```
  foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{{fun{x} {+ x {+ y z}}} 1}
```

```
--------------------------------
    y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
> foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{+ 1 {+ y z}}
```

```
--------------------------------
    y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
> foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{+ 1 {+ 1 z}}
```

```
--------------------------------
>   y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
    z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

```
{+ 1 {+ 1 {+ 1 1}}}
```

```
--------------------------------
    y   |        1
--------------------------------
    x   |        2
--------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
--------------------------------
>   z   |     {+ 1 1}
--------------------------------
    y   |     {+ 2 2}
--------------------------------
    x   |        3
--------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
--------------------------------
    z   |        7
--------------------------------
    y   |     {+ 1 2}
--------------------------------
    x   |     {+ 3 2}
--------------------------------
```

`{+ 1 {+ 1 2}}`	---------- y | 1 ---------- x | 2 ---------- mas-foo | {fun {y} {* 1 {* x y}}} ---------- > z | {+ 1 1} ---------- y | {+ 2 2} ---------- x | 3 ---------- foo | {fun{x} {+ x {+ y z}}} ---------- z | 7 ---------- y | {+ 1 2} ---------- x | {+ 3 2} ----------
`{+ 1 3}`	---------- y | 1 ---------- x | 2 ---------- mas-foo | {fun {y} {* 1 {* x y}}} ---------- > z | {+ 1 1} ---------- y | {+ 2 2} ---------- x | 3 ---------- foo | {fun{x} {+ x {+ y z}}} ---------- z | 7 ---------- y | {+ 1 2} ---------- x | {+ 3 2} ----------
`4`	---------- y | 1 ---------- x | 2 ---------- mas-foo | {fun {y} {* 1 {* x y}}} ---------- > z | {+ 1 1} ---------- y | {+ 2 2} ---------- x | 3 ---------- foo | {fun{x} {+ x {+ y z}}} ---------- z | 7 ---------- y | {+ 1 2} ---------- x | {+ 3 2} ----------

- Evaluacion glotona y alcance estático.

Solución:

Evaluación	Ambiente
`{with {x {+ 3 2}} {with {y {+ 1 2}} {with {z 7} {with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}}}}`	----------
`{with {y {+ 1 2}} {with {z 7} {with {foo {fun{x} {+ x {+ y z}}}} {with {x 3} {with {y {+ 2 2}} {with z {+ 1 1}} {with {mas-foo {fun {y} {* 1 {* x y}}}} {with {x 2} {with {y 1} {foo 1}}}}}}}}}}`	---------- x | 5 ----------

```
{with {foo {fun{x} {+ x {+ y z}}}}
  {with {x 3}
    {with {y {+ 2 2}}
      {with z {+ 1 1}}
        {with {mas-foo {fun {y} {* 1 {* x y}}}}
          {with {x 2}
            {with {y 1}
              {foo 1}}}}}}}}
```

```
-----------------------------
   z   |         7
-----------------------------
   y   |         3
-----------------------------
   x   |         5
-----------------------------
```

```
{with {x 3}
  {with {y {+ 2 2}}
    {with z {+ 1 1}}
      {with {mas-foo {fun {y} {* 1 {* x y}}}}
        {with {x 2}
          {with {y 1}
            {foo 1}}}}}}}
```

```
-----------------------------
  foo   | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |         7
-----------------------------
   y   |         3
-----------------------------
   x   |         5
-----------------------------
```

```
{with {y {+ 2 2}}
  {with z {+ 1 1}}
    {with {mas-foo {fun {y} {* 1 {* x y}}}}
      {with {x 2}
        {with {y 1}
          {foo 1}}}}}}
```

```
-----------------------------
   x   |         3
-----------------------------
  foo   | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |         7
-----------------------------
   y   |         3
-----------------------------
   x   |         5
-----------------------------
```

```
{with z {+ 1 1}}
  {with {mas-foo {fun {y} {* 1 {* x y}}}}
    {with {x 2}
      {with {y 1}
        {foo 1}}}}}
```

```
-----------------------------
   y   |         4
-----------------------------
   x   |         3
-----------------------------
  foo   | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |         7
-----------------------------
   y   |         3
-----------------------------
   x   |         5
-----------------------------
```

```
{with {mas-foo {fun {y} {* 1 {* x y}}}}
  {with {x 2}
    {with {y 1}
      {foo 1}}}}
```

```
-----------------------------
   z   |         2
-----------------------------
   y   |         4
-----------------------------
   x   |         3
-----------------------------
  foo   | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |         7
-----------------------------
   y   |         3
-----------------------------
   x   |         5
-----------------------------
```

```
{with {x 2}
  {with {y 1}
    {foo 1}}}
```

```
-----------------------------
mas-foo | {fun {y} {* 1 {* x y}}
-----------------------------
   z   |         2
-----------------------------
   y   |         4
-----------------------------
   x   |         3
-----------------------------
  foo   | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |         7
-----------------------------
   y   |         3
-----------------------------
   x   |         5
-----------------------------
```

```
  {with {y 1}
    {foo 1}}
```

```
-----------------------------
   x   |         2
-----------------------------
mas-foo | {fun {y} {* 1 {* x y}}
-----------------------------
   z   |         2
-----------------------------
   y   |         4
-----------------------------
   x   |         3
-----------------------------
  foo   | {fun{x} {+ x {+ y z}}}
-----------------------------
   z   |         7
-----------------------------
   y   |         3
-----------------------------
```

```
    x   |         5
```

```
{foo 1}
```

```
    y   |         1
    x   |         2
mas-foo | {fun {y} {* 1 {* x y}}
    z   |         2
    y   |         4
    x   |         3
  foo   | {fun{x} {+ x {+ y z}}}
    z   |         7
    y   |         3
    x   |         5
```

```
{{fun{x} {+ x {+ y z}}} 1}
```

```
    y   |         1
    x   |         2
mas-foo | {fun {y} {* 1 {* x y}}
    z   |         2
    y   |         4
    x   |         3
> foo   | {fun{x} {+ x {+ y z}}}
    z   |         7
    y   |         3
    x   |         5
```

```
{+ 1 {+ y z}}
```

```
    y   |         1
    x   |         2
mas-foo | {fun {y} {* 1 {* x y}}
    z   |         2
    y   |         4
    x   |         3
> foo   | {fun{x} {+ x {+ y z}}}
    z   |         7
    y   |         3
    x   |         5
```

```
{+ 1 {+ 3 z}}
```

```
    y   |         1
    x   |         2
mas-foo | {fun {y} {* 1 {* x y}}
    z   |         2
    y   |         4
    x   |         3
  foo   | {fun{x} {+ x {+ y z}}}
    z   |         7
>   y   |         3
    x   |         5
```

```
    y   |         1
    x   |         2
mas-foo | {fun {y} {* 1 {* x y}}
```

`{+ 1 {+ 3 7}}`	`----------` `z | 2` `----------` `y | 4` `----------` `x | 3` `----------` `foo | {fun{x} {+ x {+ y z}}}` `----------` `> z | 7` `----------` `y | 3` `----------` `x | {+ 3 2}` `----------`
`{+ 1 {+ 3 7}}`	`----------` `y | 1` `----------` `x | 2` `----------` `mas-foo | {fun {y} {* 1 {* x y}}}` `----------` `z | 2` `----------` `y | 4` `----------` `x | 3` `----------` `foo | {fun{x} {+ x {+ y z}}}` `----------` `> z | 7` `----------` `y | 3` `----------` `x | {+ 3 2}` `----------`
`{+ 1 10}`	`----------` `y | 1` `----------` `x | 2` `----------` `mas-foo | {fun {y} {* 1 {* x y}}}` `----------` `z | 2` `----------` `y | 4` `----------` `x | 3` `----------` `foo | {fun{x} {+ x {+ y z}}}` `----------` `> z | 7` `----------` `y | 3` `----------` `x | {+ 3 2}` `----------`
`11`	`----------` `y | 1` `----------` `x | 2` `----------` `mas-foo | {fun {y} {* 1 {* x y}}}` `----------` `z | 2` `----------` `y | 4` `----------` `x | 3` `----------` `foo | {fun{x} {+ x {+ y z}}}` `----------` `> z | 7` `----------` `y | 3` `----------` `x | {+ 3 2}` `----------`

- Evaluacion glotona y alcance dinámico.

Solución:

Evaluación	Ambiente
`{with {x {+ 3 2}}` `  {with {y {+ 1 2}}` `  {with {z 7}` `  {with {foo {fun{x} {+ x {+ y z}}}}` `  {with {x 3}` `  {with {y {+ 2 2}}` `  {with z {+ 1 1}}` `  {with {mas-foo {fun {y} {* 1 {* x y}}}}` `  {with {x 2}`	`----------`

```
                {with {y 1}
                  {foo 1}}}}}}}}}}}
```

```
{with {y {+ 1 2}}
  {with {z 7}
    {with {foo {fun{x} {+ x {+ y z}}}}
      {with {x 3}
        {with {y {+ 2 2}}
          {with z {+ 1 1}}
            {with {mas-foo {fun {y} {* 1 {* x y}}}}
              {with {x 2}
                {with {y 1}
                  {foo 1}}}}}}}}}}
```

```
------------------------------
   x   |         5
------------------------------
```

```
{with {foo {fun{x} {+ x {+ y z}}}}
  {with {x 3}
    {with {y {+ 2 2}}
      {with z {+ 1 1}}
        {with {mas-foo {fun {y} {* 1 {* x y}}}}
          {with {x 2}
            {with {y 1}
              {foo 1}}}}}}}}
```

```
------------------------------
   z   |         7
------------------------------
   y   |         3
------------------------------
   x   |         5
------------------------------
```

```
{with {x 3}
  {with {y {+ 2 2}}
    {with z {+ 1 1}}
      {with {mas-foo {fun {y} {* 1 {* x y}}}}
        {with {x 2}
          {with {y 1}
            {foo 1}}}}}}}
```

```
------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
------------------------------
   z   |         7
------------------------------
   y   |         3
------------------------------
   x   |         5
------------------------------
```

```
{with {y {+ 2 2}}
  {with z {+ 1 1}}
    {with {mas-foo {fun {y} {* 1 {* x y}}}}
      {with {x 2}
        {with {y 1}
          {foo 1}}}}}}
```

```
------------------------------
   x   |         3
------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
------------------------------
   z   |         7
------------------------------
   y   |         3
------------------------------
   x   |         5
------------------------------
```

```
{with z {+ 1 1}}
  {with {mas-foo {fun {y} {* 1 {* x y}}}}
    {with {x 2}
      {with {y 1}
        {foo 1}}}}}
```

```
------------------------------
   y   |         4
------------------------------
   x   |         3
------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
------------------------------
   z   |         7
------------------------------
   y   |         3
------------------------------
   x   |         5
------------------------------
```

```
{with {mas-foo {fun {y} {* 1 {* x y}}}}
  {with {x 2}
    {with {y 1}
      {foo 1}}}}
```

```
------------------------------
   z   |         2
------------------------------
   y   |         4
------------------------------
   x   |         3
------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
------------------------------
   z   |         7
------------------------------
   y   |         3
------------------------------
   x   |         5
------------------------------
```

```
{with {x 2}
  {with {y 1}
    {foo 1}}}
```

```
------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
------------------------------
   z   |         2
------------------------------
   y   |         4
------------------------------
   x   |         3
------------------------------
  foo   | {fun{x} {+ x {+ y z}}}
------------------------------
   z   |         7
------------------------------
   y   |         3
------------------------------
   x   |         5
------------------------------
```

```
{with {y 1}
  {foo 1}}
```

```
---------------------------------
   x   |         2
---------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------------
   z   |         2
---------------------------------
   y   |         4
---------------------------------
   x   |         3
---------------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------------
   z   |         7
---------------------------------
   y   |         3
---------------------------------
   x   |         5
---------------------------------
```

```
{foo 1}
```

```
---------------------------------
   y   |         1
---------------------------------
   x   |         2
---------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------------
   z   |         2
---------------------------------
   y   |         4
---------------------------------
   x   |         3
---------------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------------
   z   |         7
---------------------------------
   y   |         3
---------------------------------
   x   |         5
---------------------------------
```

```
{{fun{x} {+ x {+ y z}}} 1}
```

```
---------------------------------
   y   |         1
---------------------------------
   x   |         2
---------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------------
   z   |         2
---------------------------------
   y   |         4
---------------------------------
   x   |         3
---------------------------------
> foo  | {fun{x} {+ x {+ y z}}}
---------------------------------
   z   |         7
---------------------------------
   y   |         3
---------------------------------
   x   |         5
---------------------------------
```

```
{+ 1 {+ y z}}
```

```
---------------------------------
>  y   |         1
---------------------------------
   x   |         2
---------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------------
   z   |         2
---------------------------------
   y   |         4
---------------------------------
   x   |         3
---------------------------------
  foo  | {fun{x} {+ x {+ y z}}}
---------------------------------
   z   |         7
---------------------------------
   y   |         3
---------------------------------
   x   |         5
---------------------------------
```

```
{+ 1 {+ 1 z}}
```

```
---------------------------------
   y   |         1
---------------------------------
   x   |         2
---------------------------------
mas-foo | {fun {y} {* 1 {* x y}}
---------------------------------
   z   |         2
---------------------------------
   y   |         4
---------------------------------
   x   |         3
---------------------------------
```

	`> foo | {fun{x} {+ x {+ y z}}}` `z | 7` `y | 3` `x | 5`
`{+ 1 {+ 1 2}}`	`y | 1` `x | 2` `mas-foo | {fun {y} {* 1 {* x y}}}` `> z | 2` `y | 4` `x | 3` `foo | {fun{x} {+ x {+ y z}}}` `z | 7` `y | 3` `x | 5`
`{+ 1 3}`	`y | 1` `x | 2` `mas-foo | {fun {y} {* 1 {* x y}}}` `> z | {+ 1 1}` `y | {+ 2 2}` `x | 3` `foo | {fun{x} {+ x {+ y z}}}` `z | 7` `y | {+ 1 2}` `x | {+ 3 2}`
`4`	`y | 1` `x | 2` `mas-foo | {fun {y} {* 1 {* x y}}}` `> z | {+ 1 1}` `y | {+ 2 2}` `x | 3` `foo | {fun{x} {+ x {+ y z}}}` `z | 7` `y | {+ 1 2}` `x | {+ 3 2}`

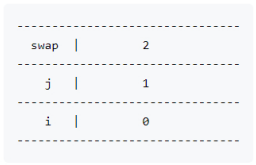
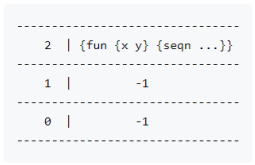
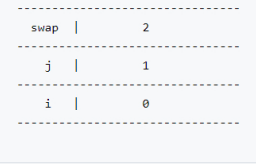
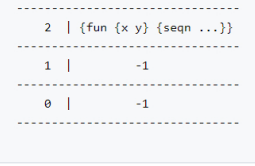
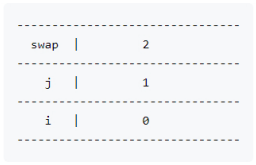
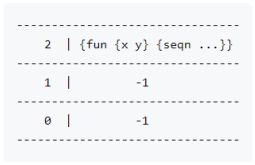
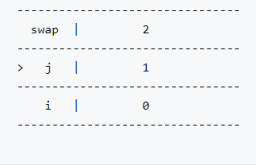
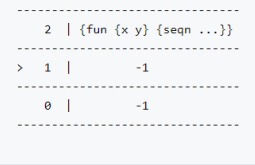
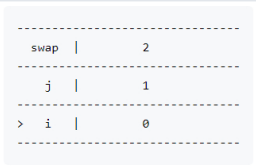
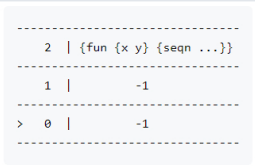
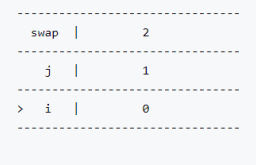
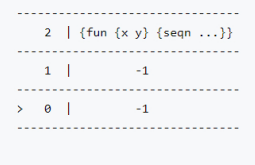
Es necesario expresar el ambiente final (stack) para evaluacion glotona y perezosa; ademas de la expresion completa a evaluar en cada uno de los incisos anteriores, antes de dar el resultado final de tales evaluaciones.

2. Evalua las siguientes expresiones usando cada uno de los pasos de parametros que se solicitan, debes de poner la ultima expresion a evaluar antes de dar el resultado final de la misma, usando:

   - Paso de parametros por valor.

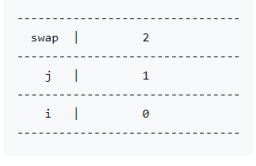
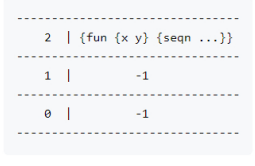
     Solución:

Evaluación	Ambiente	Store
`{with*` `{` `{i -1}` `{j -1}` `{swap {fun {x y}` `{seqn` `{set tmp x}` `{set x y}`	`---`	`---`

`{set y tmp}}}}` `}` `{seqn` `{swap i j}` `{- j i}}}`		
`{with*` `{` `{i -1}` `{j -1}` `{swap {fun {x y}` `{seqn` `{set tmp x}` `{set x y}` `{set y tmp}}}}` `}` `{seqn` `{swap i j}` `{- j i}}}`		
`{seqn` `{swap i j}` `{- j i}}`		
`{swap i j}`		
`{- -1 i}`		
`{- -1 -1}`		
`0`		

- Paso de parámetros por referencia.

  Solución:

Evaluación	Ambiente	Store
`{with*` `{` `{i -1}` `{j -1}` `{swap {fun {x y}` `{seqn` `{set tmp x}` `{set x y}` `{set y tmp}}}}` `}` `{seqn` `{swap i j}` `{- j i}}}`		
`{with*` `{` `{i -1}` `{j -1}` `{swap {fun {x y}` `{seqn` `{set tmp x}` `{set x y}` `{set y tmp}}}}` `}` `{seqn`		

`{swap i j}` `{- j i}}}`		
`{seqn` `{swap i j}` `{- j i}}`	``` swap | 2 j | 1 i | 0 ```	``` 2 | {fun {x y} {seqn ...}} 1 | -1 0 | -1 ```
`{swap i j}`	``` swap | 2 j | 0 i | 1 ```	``` 2 | {fun {x y} {seqn ...}} 1 | -1 0 | -1 ```
`{- -1 i}`	``` swap | 2 > j | 0 i | 1 ```	``` 2 | {fun {x y} {seqn ...}} 1 | -1 > 0 | -1 ```
`{- -1 -1}`	``` swap | 2 j | 0 > i | 1 ```	``` 2 | {fun {x y} {seqn ...}} > 1 | -1 0 | -1 ```
`0`	``` swap | 2 j | 0 > i | 1 ```	``` 2 | {fun {x y} {seqn ...}} > 1 | -1 > 0 | -1 ```

3. ¿Da dos ejemplos en el lenguaje *RCFWAE* de transparencia refererencial?

- Ejemplo 1:

```
{with {x {+ 2 2}}
  {with {y {+ 1 3}}
    {+ x y}}} ;; -> 8

{with {x {* 2 2}}
  {with {y {add1 3}}
    {+ x y}}} ;; -> 8
```

- Ejemplo 2:

```
{with {c {+ 1 5}}
  {if0 {- c 6}
    {anD true true false}
    true}} ;; -> false

{with {c 6}
  {if0 {- {* 2 c} 12}
    {anD true true false}
    true}} ;; -> false
```

4. Dentro del Calculo Lambda, evalua cada una de las siguientes expresiones usando $\beta-$reducciones. Si alguna tiene forma normal, especificala.

- $(\lambda x.\, x)(\lambda x.\, xxx)$

$$
\begin{aligned}
&(\lambda x.\, x)(\lambda x.\, xxx)\\
&\to_\beta (\lambda x.\, xxx)\\
&\to_\beta (\lambda x.\, xxx)
\end{aligned}
$$

- $(\lambda x.\, (\lambda y.\, yxw)z)u$

$$
\begin{aligned}
&(\lambda x.\, (\lambda y.\, yxw)z)u\\
&\to_\beta (\lambda y.\, yuw)z\\
&\to_\beta zuw
\end{aligned}
$$

- $(\lambda x.\, \lambda y.\, \lambda z.\, x)(yz)$

$$
\begin{aligned}
&(\lambda x.\, \lambda y.\, \lambda z.\, x)(yz)\\
&\to_\beta (\lambda y.\, \lambda z.\, yz)
\end{aligned}
$$

5. ¿Da un ejemplo en Cálculo Lambda (distintos a los vistos en clase) donde se aplique el **teorema de confluencia**? Haz la reduccion completa en cada caso.

$$(\lambda x.\, (\lambda y.\, (\lambda z.\, zx)y)xz)v \to_\beta (\lambda y.\, (\lambda z.\, zx)y)vz$$

$$(\lambda x.\, (\lambda y.\, (\lambda z.\, zx)y)xz)v \to_\beta (\lambda x.\, (\lambda y.\, yx)xz)v$$

6. Da un ejemplo en Racket, donde uses la estrucuta de cajas y expongas el concepto de **estado** y **SPS**. En el ejemplo se debe reflejar el cambio de estado de una variable definida como una caja, cuyo valor dentro de la caja sea inicialmente 0 (cero) y termine con valor de 2, teniendo un valor de 1 de forma intermedia.

Solución:

Evaluación	Ambiente	Store
`{with {b {newbox 0}}` `  {seqn` `  {setbox b 1}` `  {setbox b 2}` `  {openbox b}}}`	----------	----------
`{seqn` `  {setbox b 1}` `  {setbox b 2}` `  {openbox b}}`	---------- b | 0 ----------	---------- > 1 | 0 ---------- 0 | | 1 |
`{setbox b 1}`	---------- b | 0 ----------	---------- > 1 | 1 ---------- 1 | 0 ---------- 0 | | 1 |
`{setbox b 2}`	---------- b | 0 ----------	---------- > 1 | 2 ---------- 1 | 1 ---------- 1 | 0 ---------- 0 | | 1 |
`{openbox b}`	---------- > b | 0 ----------	---------- 1 | 2 ---------- 1 | 1 ---------- 1 | 0 ---------- > 0 | | 1 |
`2`	---------- > b | 0 ----------	---------- > 1 | 2 ---------- 1 | 1 ---------- 1 | 0 ---------- 0 | | 1 |

7. Del siguiente codigo en Racket:

```
(define (filter-neg l)
  (cond
    ((nempty? l) empty)
    (else
      (if (< (nfirst l) 0)
        (cons (nfirst l) (filter-neg (nrest l)))
        (filter-neg (nrest l))))))
```

- Convierte el codigo anterior usando recursion de cola.

```
(define (filter-neg l acc)
  (cond
    ((nempty? l) acc)
    (else
        (if (< (nfirst l) 0)
          (filter-neg (nrest l) (snoc acc (nfirst l)))
          (filter-neg (nrest l) acc)))))
```

- ¿Cuantos registros de activacion se crean usando recursion de cola cuando recibe la lista `'(0 1 -1 0 -4 1 -2)`? Explica como se va creando el stack de ejecucion.

Solución:

Stack de ejecución
`(filter-neg '(0 1 -1 0 -4 1 -2) '())`
`(filter-neg '(1 -1 0 -4 1 -2) '())`

```
(filter-neg '(-1 0 -4 1 -2) '())
```

```
(filter-neg '(0 -4 1 -2) '(-1))
```

```
(filter-neg '(-4 1 -2) '(-1))
```

```
(filter-neg '(1 -2) '(-1 -4))
```

```
(filter-neg '(-2) '(-1 -4))
```

```
(filter-neg '() '(-1 -4 -2))
```

```
'(-1 -4 -2)
```

- ¿Cuantos registros de activacion se crean usando la implementacion de recursion con la misma instancia que en el inciso anterior? Explica como es que se va creando el stack de ejecucion.

Solución:

Stack de ejecución

```
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2))
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
(filter-neg '(-1 0 -4 1 -2))
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2))
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
(filter-neg '(0 -4 1 -2))
--------------------------------
(filter-neg '(-1 0 -4 1 -2))
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2))
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
(filter-neg '(-4 1 -2))
--------------------------------
(filter-neg '(0 -4 1 -2))
--------------------------------
(filter-neg '(-1 0 -4 1 -2))
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2))
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
(filter-neg '(1 -2))
--------------------------------
(filter-neg '(-4 1 -2))
--------------------------------
(filter-neg '(0 -4 1 -2))
--------------------------------
(filter-neg '(-1 0 -4 1 -2))
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2))
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
(filter-neg '(-2))
--------------------------------
(filter-neg '(1 -2))
--------------------------------
(filter-neg '(-4 1 -2))
--------------------------------
(filter-neg '(0 -4 1 -2))
--------------------------------
(filter-neg '(-1 0 -4 1 -2))
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2))
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
'()
--------------------------------
(filter-neg '(-2))
--------------------------------
(filter-neg '(1 -2))
--------------------------------
(filter-neg '(-4 1 -2))
--------------------------------
(filter-neg '(0 -4 1 -2))
--------------------------------
(filter-neg '(-1 0 -4 1 -2))
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2))
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2))
```

```
--------------------------------
'()
--------------------------------
(cons -2 (filter-neg '())) = '(-2)
--------------------------------
(filter-neg '(-2)) = '(-2)'
--------------------------------
(cons -4 (filter-neg '(1 -2))) = '(-4 -2)
--------------------------------
(filter-neg '(-4 1 -2)) = '(-4 -2)
--------------------------------
(cons -1 (filter-neg '(0 -4 1 -2))) = '(-1 -4 -2)
--------------------------------
(filter-neg '(-1 0 -4 1 -2)) = '(-1 -4 -2)
--------------------------------
(filter-neg '(1 -1 0 -4 1 -2)) = '(-1 -4 -2)
--------------------------------
(filter-neg '(0 1 -1 0 -4 1 -2)) = '(-1 -4 -2)
```