Lenguajes de Programación - Examen 2

Integrantes

Nombre	No. de cuenta
Cureño Sánchez Misael	418002485

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}
---------------------------------
```

```
{{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 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}
          {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}
--------------------------------
```

```
{{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
---------------------------------
```

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

```
--------------------------------
  swap  |         2
--------------------------------
    j   |         1
--------------------------------
    i   |         0
--------------------------------
```

```
--------------------------------
    2   | {fun {x y} {seqn ...}}
--------------------------------
    1   |         -1
--------------------------------
    0   |         -1
--------------------------------
```

```
{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   |         1
--------------------------------
    i   |         0
--------------------------------
```

```
--------------------------------
    2   | {fun {x y} {seqn ...}}
--------------------------------
    1   |         -1
--------------------------------
    0   |         -1
--------------------------------
```

```
{- -1 i}
```

```
--------------------------------
  swap  |         2
--------------------------------
>   j   |         1
--------------------------------
    i   |         0
--------------------------------
```

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

```
{- -1 -1}
```

```
--------------------------------
  swap  |         2
--------------------------------
    j   |         1
--------------------------------
>   i   |         0
--------------------------------
```

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

```
0
```

```
--------------------------------
  swap  |         2
--------------------------------
    j   |         1
--------------------------------
>   i   |         0
--------------------------------
```

```
--------------------------------
    2  | {fun {x y} {seqn ...}}
--------------------------------
```

```
    1  |         -1
-------------------------------
>   0  |         -1
-------------------------------
```

- Paso de parametros por referencia.

Solución:

Evaluación	Ambiente	Store

```
{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.

  <br>
```

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}}}
```

```
--------------------------------
  swap  |         2
```

```
--------------------------------
    j   |         1
--------------------------------
    i   |         0
--------------------------------
```

```
--------------------------------
    2   | {fun {x y} {seqn ...}}
--------------------------------
    1   |         -1
--------------------------------
    0   |         -1
--------------------------------
```

```
{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   |         1
```

```
--------------------------------
    i   |         0
--------------------------------
```

```
--------------------------------
    2   | {fun {x y} {seqn ...}}
--------------------------------
    1   |         -1
--------------------------------
    0   |         -1
--------------------------------
```

```
{- -1 i}
```

```
--------------------------------
  swap  |         2
--------------------------------
>   j   |         1
--------------------------------
    i   |         0
--------------------------------
```

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

```
{- -1 -1}
```

```
--------------------------------
  swap  |         2
--------------------------------
    j   |         1
--------------------------------
>   i   |         0
--------------------------------
```

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

```
0
```

```
--------------------------------
  swap  |         2
--------------------------------
    j   |         1
--------------------------------
>   i   |         0
--------------------------------
```

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

- 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}}}
```

```
--------------------------------
  swap  |         2
--------------------------------
    j   |         1
--------------------------------
    i   |         0
--------------------------------
```

```
--------------------------------
    2   | {fun {x y} {seqn ...}}
--------------------------------
    1   |        -1
--------------------------------
    0   |        -1
--------------------------------
```

```
{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.

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

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

$$\rightarrow_\beta (\lambda x.xxx)$$

$$\rightarrow_\beta (\lambda x.xxx)$$

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

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

$$\rightarrow_\beta (\lambda y.yuw)z$$

$$\rightarrow_\beta zuw$$

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

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

$$\rightarrow_\beta (\lambda y.\lambda z.yz)$$

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.

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

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

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)
```