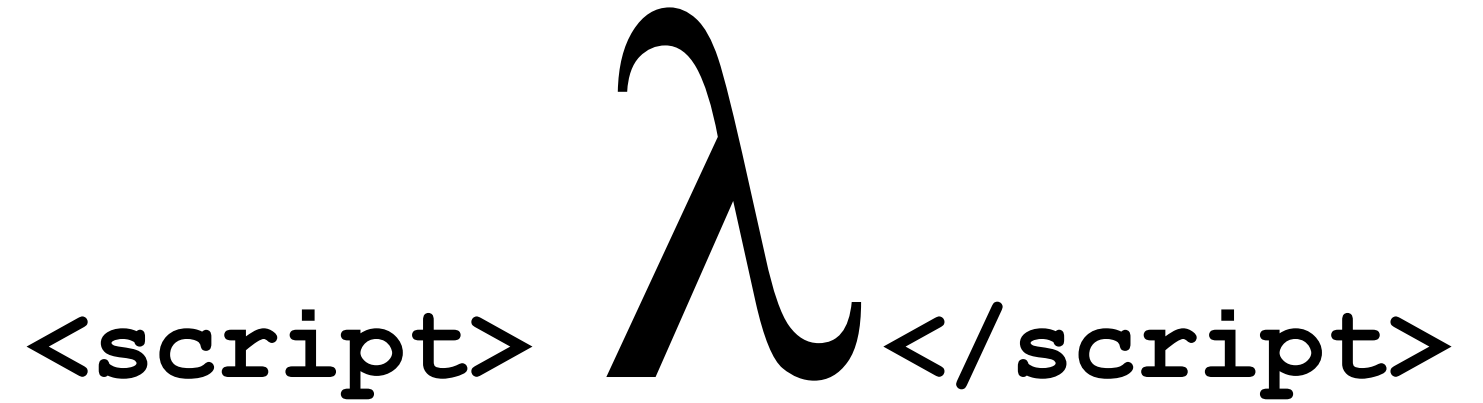

JSHC

JavaScript Haskell Compiler

Vad är det?

En kompilator, som kompilerar

Haskell  till JavaScript `<script>`

```
foo x = f x 1
```

```
foo = function(x) {
  return f(x)(1)
};
```

Vad är det?

En kompilator, som kompilerar

Haskell  till JavaScript `<script>`

```
foo x = f x 1
```

```
foo = function(x) {
  return f(x)(1)
};
```

Skriven i JavaScript

Varför JavaScript?

Varför JavaScript?

JavaScript är de facto

standard för

klientbaserad skriptning

Vad är JavaScript?

Vad är JavaScript?

Imperativt

Vad är JavaScript?

Imperativt

Objektorienterat

Vad är JavaScript?

Imperativt

Objektorienterat

Dynamiskt typat

Vad är JavaScript?

Imperativt

Objektorienterat

Dynamiskt typat

Första klassens funktioner

Varför ska man översätta JavaScript?

Ett exempel på JavaScript-kod ur verkliga livet: Autocomplete i ett textfält

```
var suggestions = new Array("Boris", "Bäcker", "Peter", "Test","Bums");
var outp;
var oldins;
var posi = -1;
var words = new Array();
var input;
var key;
function setVisible(visi){
        var x = document.getElementById("shadow");
        var t = document.getElementsByName("text")[0];
        x.style.position = 'absolute';
        x.style.top =  (findPosY(t)+3)+"px";
        x.style.left = (findPosX(t)+2)+"px";
        x.style.visibility = visi;
}
function init(){
        outp = document.getElementById("output");
        window.setInterval("lookAt()", 100);
        setVisible("hidden");
        document.onkeydown = keygetter; //needed for Opera...
        document.onkeyup = keyHandler;
}

function findPosY(obj)
{
        var curtop = 0;
        if (obj.offsetParent){
                curtop += obj.offsetHeight;
                while (obj.offsetParent){
                        curtop += obj.offsetTop;
                        obj = obj.offsetParent;
                }
        }
        else if (obj.y){
                curtop += obj.y;
                curtop += obj.height;
        }
        return curtop;
}


        oldins = this.firstChild.nodeValue;
}

function lookAt(){
        var ins = document.getElementsByName("text")[0].value;
        if (oldins == ins) return;
        else if (posi > -1);
        else if (ins.length > 0){
                words = getWord(ins);
                if (words.length > 0){
                        clearOutput();
                        for (var i=0;i < words.length; ++i) addWord (words[i]);
                        setVisible("visible");
                        input = document.getElementsByName("text")[0].value;
                }
                else{
                        setVisible("hidden");
                        posi = -1;
                }
        }
        else{
                setVisible("hidden");
                posi = -1;
        }
        oldins = ins;
}
```

```
function findPosX(obj)
{
        var curleft = 0;
        if (obj.offsetParent){
                while (obj.offsetParent){
                        curleft += obj.offsetLeft;
                        obj = obj.offsetParent;
                }
        }
        else if (obj.x)
                curleft += obj.x;
        return curleft;
}

function addWord(word){
        var sp = document.createElement("div");
        sp.appendChild(document.createTextNode(word));
        sp.onmouseover = mouseHandler;
        sp.onmouseout = mouseHandlerOut;
        sp.onclick = mouseClick;
        outp.appendChild(sp);
}

function clearOutput(){
        while (outp.hasChildNodes()){
                noten=outp.firstChild;
                outp.removeChild(noten);
        }
        posi = -1;
}

function getWord(beginning){
        var words = new Array();
        for (var i=0;i < suggestions.length; ++i){
                var j = -1;
                var correct = 1;
                while (correct == 1 && ++j < beginning.length){
                        if (suggestions[i].charAt(j) != beginning.charAt(j)) correct = 0;
                }
                if (correct == 1) words[words.length] = suggestions[i];
        }
        return words;
}


function setColor (_posi, _color, _forg){
        outp.childNodes[_posi].style.background = _color;
        outp.childNodes[_posi].style.color = _forg;
}

function keygetter(event){
        if (!event && window.event) event = window.event;
        if (event) key = event.keyCode;
        else key = event.which;
}
```

```
function keyHandler(event){
        if (document.getElementById("shadow").style.visibility == "visible"){
        var textfield = document.getElementsByName("text")[0];
        if (key == 40){ //Key down
                //alert (words);
                if (words.length > 0 && posi  words.length-1){
                        if (posi >=0) setColor(posi, "#fff", "black");
                        else input = textfield.value;
                        setColor(++posi, "blue", "white");
                        textfield.value = outp.childNodes[posi].firstChild.nodeValue;
                }
        }
        else if (key == 38){ //Key up
                if (words.length > 0 && posi >= 0){
                        if (posi >=1){
                                setColor(posi, "#fff", "black");
                                setColor(--posi, "blue", "white");
                                textfield.value = outp.childNodes[posi].firstChild.nodeValue;
                        }
                        else{
                                setColor(posi, "#fff", "black");
                                textfield.value = input;
                                textfield.focus();
                                posi--;
                        }
                }
        }
        else if (key == 27){ // Esc
                textfield.value = input;
                setVisible("hidden");
                posi = -1;
                oldins = input;
        }
        else if (key == 8){ // Backspace
                posi = -1;
                oldins=-1;
        }
        }
}

var mouseHandler=function(){
        for (var i=0; i < words.length; ++i)
                setColor (i, "white", "black");

        this.style.background = "blue";
        this.style.color= "white";
}

var mouseHandlerOut=function(){
        this.style.background = "white";
        this.style.color= "black";
}

var mouseClick=function(){
        document.getElementsByName("text")[0].value = this.firstChild.nodeValue;
        setVisible("hidden");
        Posi = -1;
        oldins = this.firstChild.nodeValue;
}
```

2

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                        curtop += obj.offsetTop;
                        obj = obj.offsetParent;
                }
        }
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                curtop += obj.y;
                curtop += obj.height;
        }
        return curtop;
}


        oldins = this.firstChild.nodeValue;
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function lookAt(){
        var ins = document.getElementsByName("text")[0].value;
        if (oldins == ins) return;
        else if (posi > -1);
        else if (ins.length > 0){
                words = getWord(ins);
                if (words.length > 0){
                        clearOutput();
                        for (var i=0;i < words.length; ++i) addWord (words[i]);
                        setVisible("visible");
                        input = document.getElementsByName("text")[0].value;
                }
                else{
                        setVisible("hidden");
                        posi = -1;
                }
        }
        else{
                setVisible("hidden");
                posi = -1;
        }
        oldins = ins;
}
```

```
function findPosX(obj)
{
        var curleft = 0;
        if (obj.offsetParent){
                while (obj.offsetParent){
                        curleft += obj.offsetLeft;
                        obj = obj.offsetParent;
                }
        }
        else if (obj.x)
                curleft += obj.x;
        return curleft;
}

function addWord(word){
        var sp = document.createElement("div");
        sp.appendChild(document.createTextNode(word));
        sp.onmouseover = mouseHandler;
        sp.onmouseout = mouseHandlerOut;
        sp.onclick = mouseClick;
        outp.appendChild(sp);
}

function clearOutput(){
        while (outp.hasChildNodes()){
                noten=outp.firstChild;
                outp.removeChild(noten);
        }
        posi = -1;
}

function getWord(beginning){
        var words = new Array();
        for (var i=0;i < suggestions.length; ++i){
                var j = -1;
                var correct = 1;
                while (correct == 1 && ++j < beginning.length){
                        if (suggestions[i].charAt(j) != beginning.charAt(j)) correct = 0;
                }
                if (correct == 1) words[words.length] = suggestions[i];
        }
        return words;
}


function setColor (_posi, _color, _forg){
        outp.childNodes[_posi].style.background = _color;
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```
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        if (document.getElementById("shadow").style.visibility == "visible"){
        var textfield = document.getElementsByName("text")[0];
        if (key == 40){ //Key down
                //alert (words);
                if (words.length > 0 && posi  words.length-1){
                        if (posi >=0) setColor(posi, "#fff", "black");
                        else input = textfield.value;
                        setColor(++posi, "blue", "white");
                        textfield.value = outp.childNodes[posi].firstChild.nodeValue;
                }
        }
        else if (key == 38){ //Key up
                if (words.length > 0 && posi >= 0){
                        if (posi >=1){
                                setColor(posi, "#fff", "black");
                                setColor(--posi, "blue", "white");
                                textfield.value = outp.childNodes[posi].firstChild.nodeValue;
                        }
                        else{
                                setColor(posi, "#fff", "black");
                                textfield.value = input;
                                textfield.focus();
                                posi--;
                        }
                }
        }
        else if (key == 27){ // Esc
                textfield.value = input;
                setVisible("hidden");
                posi = -1;
                oldins = input;
        }
        else if (key == 8){ // Backspace
                posi = -1;
                oldins=-1;
        }
        }
}

var mouseHandler=function(){
        for (var i=0; i < words.length; ++i)
                setColor (i, "white", "black");

        this.style.background = "blue";
        this.style.color= "white";
}

var mouseHandlerOut=function(){
        this.style.background = "white";
        this.style.color= "black";
}

var mouseClick=function(){
        document.getElementsByName("text")[0].value = this.firstChild.nodeValue;
        setVisible("hidden");
        Posi = -1;
        oldins = this.firstChild.nodeValue;
}
```

Hitta typfelet!

```
var suggestions = new Array("Boris", "Bäcker", "Peter", "Test","Bums");
var outp;
var oldins;
var posi = -1;
var words = new Array();
var input;
var key;
function setVisible(visi){
        var x = document.getElementById("shadow");
        var t = document.getElementsByName("text")[0];
        x.style.position = 'absolute';
        x.style.top =  (findPosY(t)+3)+"px";
        x.style.left = (findPosX(t)+2)+"px";
        x.style.visibility = visi;
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function init(){
        outp = document.getElementById("output");
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        document.onkeydown = keygetter; //needed for Opera...
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}

function findPosY(obj)
{
        var curtop = 0;
        if (obj.offsetParent){
                curtop += obj.offsetHeight;
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                        curtop += obj.offsetTop;
                        obj = obj.offsetParent;
                }
        }
        else if (obj.y){
                curtop += obj.y;
                curtop += obj.height;
        }
        return curtop;
}


        oldins = this.firstChild.nodeValue;
}

function lookAt(){
        var ins = document.getElementsByName("text")[0].value;
        if (oldins == ins) return;
        else if (posi > -1);
        else if (ins.length > 0){
                words = getWord(ins);
                if (words.length > 0){
                        clearOutput();
                        for (var i=0;i < words.length; ++i) addWord (words[i]);
                        setVisible("visible");
                        input = document.getElementsByName("text")[0].value;
                }
                else{
                        setVisible("hidden");
                        posi = -1;
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        }
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        }
        oldins = ins;
}
```

```
function findPosX(obj)
{
        var curleft = 0;
        if (obj.offsetParent){
                while (obj.offsetParent){
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                        obj = obj.offsetParent;
                }
        }
        else if (obj.x)
                curleft += obj.x;
        return curleft;
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function addWord(word){
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        outp.appendChild(sp);
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function clearOutput(){
        while (outp.hasChildNodes()){
                noten=outp.firstChild;
                outp.removeChild(noten);
        }
        posi = -1;
}

function getWord(beginning){
        var words = new Array();
        for (var i=0;i < suggestions.length; ++i){
                var j = -1;
                var correct = "1";
                while (correct == 1 && ++j < beginning.length){
                        if (suggestions[i].charAt(j) != beginning.charAt(j)) correct = 0;
                }
                if (correct == 1) words[words.length] = suggestions[i];
        }
        return words;
}


function setColor (_posi, _color, _forg){
        outp.childNodes[_posi].style.background = _color;
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                        else input = textfield.value;
                        setColor(++posi, "blue", "white");
                        textfield.value = outp.childNodes[posi].firstChild.nodeValue;
                }
        }
        else if (key == 38){ //Key up
                if (words.length > 0 && posi >= 0){
                        if (posi >=1){
                                setColor(posi, "#fff", "black");
                                setColor(--posi, "blue", "white");
                                textfield.value = outp.childNodes[posi].firstChild.nodeValue;
                        }
                        else{
                                setColor(posi, "#fff", "black");
                                textfield.value = input;
                                textfield.focus();
                                posi--;
                        }
                }
        }
        else if (key == 27){ // Esc
                textfield.value = input;
                setVisible("hidden");
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                oldins=-1;
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        }
}

var mouseHandler=function(){
        for (var i=0; i < words.length; ++i)
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        this.style.background = "blue";
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}

var mouseHandlerOut=function(){
        this.style.background = "white";
        this.style.color= "black";
}

var mouseClick=function(){
        document.getElementsByName("text")[0].value = this.firstChild.nodeValue;
        setVisible("hidden");
        Posi = -1;
        oldins = this.firstChild.nodeValue;
}
```

Klipp och klistra

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var suggestions = new Array("Boris", "Bäcker", "Peter", "Test","Bums");
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}

function findPosY(obj)
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        if (obj.offsetParent){
                curtop += obj.offsetHeight;
                while (obj.offsetParent){
                        curtop += obj.offsetTop;
                        obj = obj.offsetParent;
                }
        }
        else if (obj.y){
                curtop += obj.y;
                curtop += obj.height;
        }
        return curtop;
}


        oldins = this.firstChild.nodeValue;
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function lookAt(){
        var ins = document.getElementsByName("text")[0].value;
        if (oldins == ins) return;
        else if (posi > -1);
        else if (ins.length > 0){
                words = getWord(ins);
                if (words.length > 0){
                        clearOutput();
                        for (var i=0;i < words.length; ++i) addWord (words[i]);
                        setVisible("visible");
                        input = document.getElementsByName("text")[0].value;
                }
                else{
                        setVisible("hidden");
                        posi = -1;
                }
        }
        else{
                setVisible("hidden");
                posi = -1;
        }
        oldins = ins;
}
```

```
function findPosX(obj)
{
        var curleft = 0;
        if (obj.offsetParent){
                while (obj.offsetParent){
                        curleft += obj.offsetLeft;
                        obj = obj.offsetParent;
                }
        }
        else if (obj.x)
                curleft += obj.x;
        return curleft;
}

function addWord(word){
        var sp = document.createElement("div");
        sp.appendChild(document.createTextNode(word));
        sp.onmouseover = mouseHandler;
        sp.onmouseout = mouseHandlerOut;
        sp.onclick = mouseClick;
        outp.appendChild(sp);
}

function clearOutput(){
        while (outp.hasChildNodes()){
                noten=outp.firstChild;
                outp.removeChild(noten);
        }
        posi = -1;
}

function getWord(beginning){
        var words = new Array();
        for (var i=0;i < suggestions.length; ++i){
                var j = -1;
                var correct = 1;
                while (correct == 1 && ++j < beginning.length){
                        if (suggestions[i].charAt(j) != beginning.charAt(j)) correct = 0;
                }
                if (correct == 1) words[words.length] = suggestions[i];
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        return words;
}


function setColor (_posi, _color, _forg){
        outp.childNodes[_posi].style.background = _color;
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function keyHandler(event){
        if (document.getElementById("shadow").style.visibility == "visible"){
        var textfield = document.getElementsByName("text")[0];
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                        else input = textfield.value;
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                if (words.length > 0 && posi >= 0){
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                                setColor(--posi, "blue", "white");
                                textfield.value = outp.childNodes[posi].firstChild.nodeValue;
                        }
                        else{
                                setColor(posi, "#fff", "black");
                                textfield.value = input;
                                textfield.focus();
                                posi--;
                        }
                }
        }
        else if (key == 27){ // Esc
                textfield.value = input;
                setVisible("hidden");
                posi = -1;
                oldins = input;
        }
        else if (key == 8){ // Backspace
                posi = -1;
                oldins=-1;
        }
        }
}

var mouseHandler=function(){
        for (var i=0; i < words.length; ++i)
                setColor (i, "white", "black");

        this.style.background = "blue";
        this.style.color= "white";
}

var mouseHandlerOut=function(){
        this.style.background = "white";
        this.style.color= "black";
}

var mouseClick=function(){
        document.getElementsByName("text")[0].value = this.firstChild.nodeValue;
        setVisible("hidden");
        Posi = -1;
        oldins = this.firstChild.nodeValue;
}
```

En lösning: Bibliotek

En lösning: Bibliotek

Abstraktion genom funktioner

En lösning: Bibliotek

Abstraktion genom funktioner

Ad-hoc-lösning

En lösning: Bibliotek

Abstraktion genom funktioner

Ad-hoc-lösning

Osäkert gränssnitt

Möjligheter att använda Haskell för webprogrammering finns redan

Möjligheter att använda Haskell för webprogrammering finns redan

- Serverramverk
  - Happstack
  - Yesod

Möjligheter att använda Haskell för webprogrammering finns redan

Serverramverk
- Happstack
- Yesod

Kompilatorer till JavaScript
- GHCjs
- UHC

Varför just Haskell?

Varför just Haskell?

- Vi är Haskellprogrammerare!
  - Använda redan existerande kod

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Varför just Haskell?

- Vi är Haskellprogrammerare!
  - Använda redan existerande kod
- Kraftfullt typsystem
- Modulsystem
- Lat evaluering

```
ones = 1:ones
```

Nu är det dags för demon!

Kompilering: en översikt

Kompilering: en översikt

Tre steg

Kompilering: en översikt

Tre steg

- Abstrakt representation

Kompilering: en översikt

Tre steg

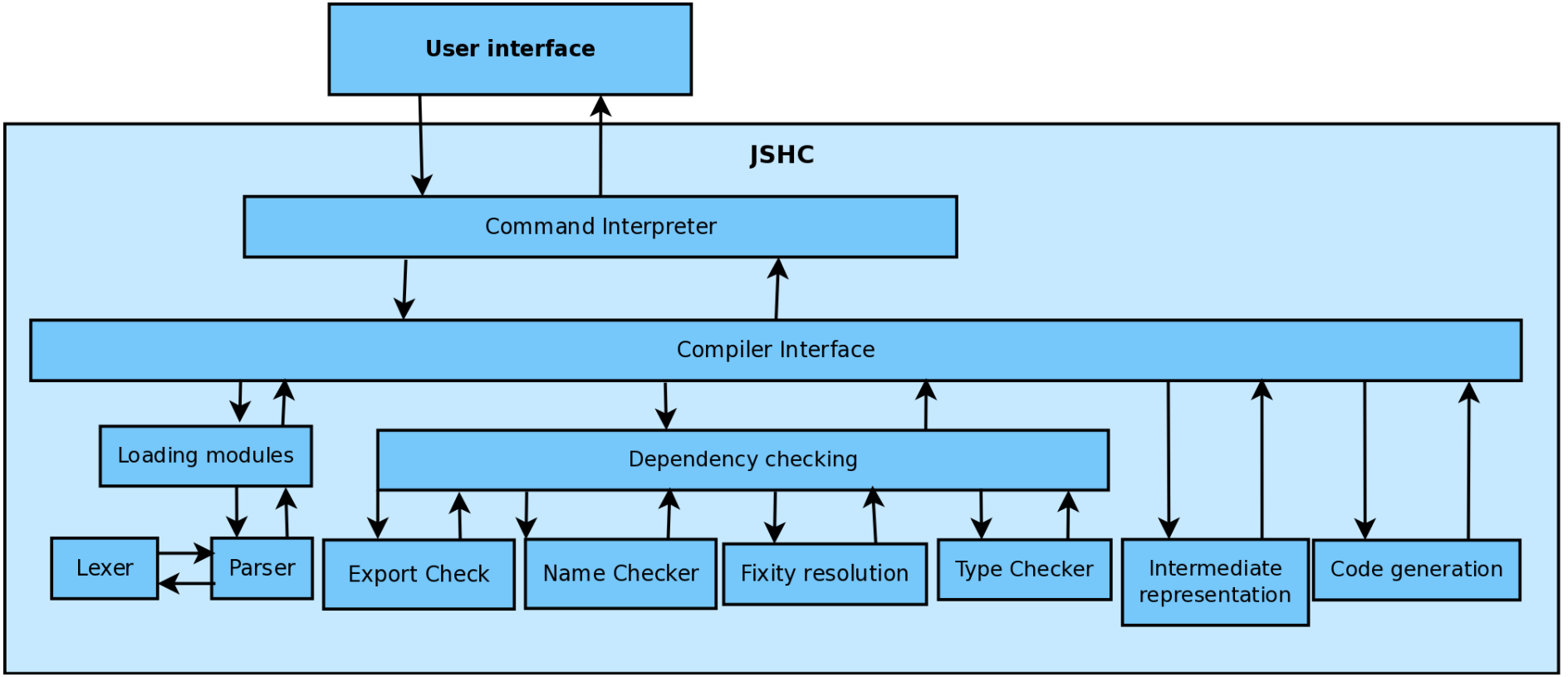
- Abstrakt representation
- Kontroll av representation

Kompilering: en översikt

Tre steg

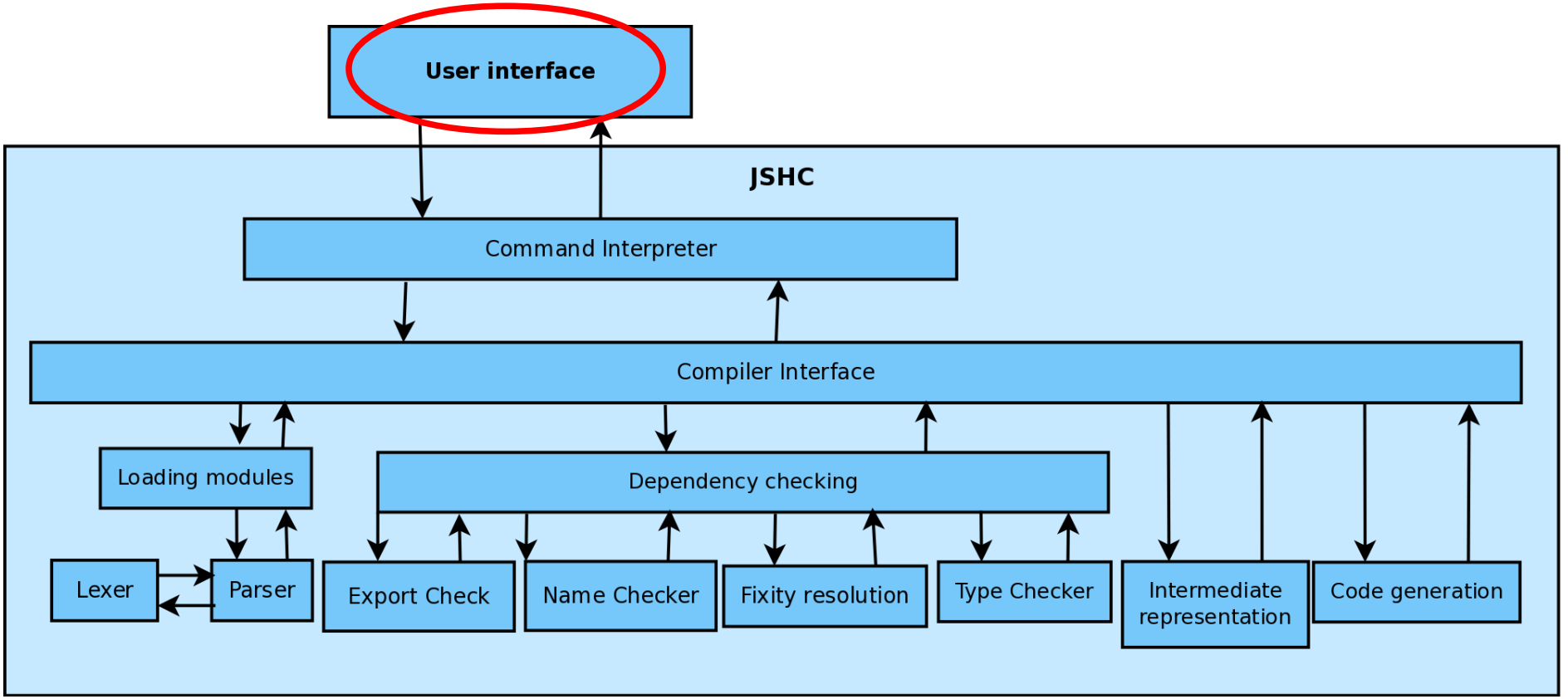
- Abstrakt representation
- Kontroll av representation
- Generering av målrepresentation

Hur fungerar JSHC?



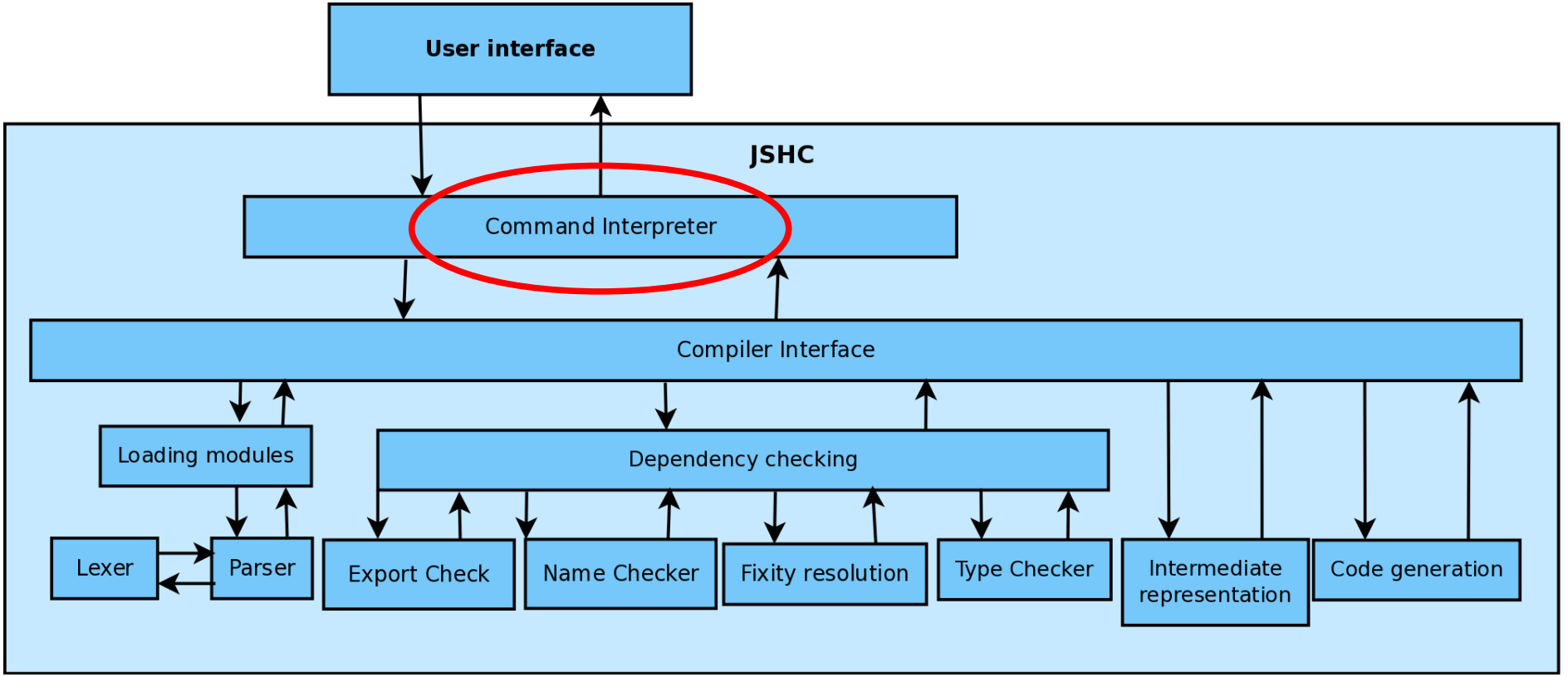
Hur fungerar JSHC?

Kommando skickas



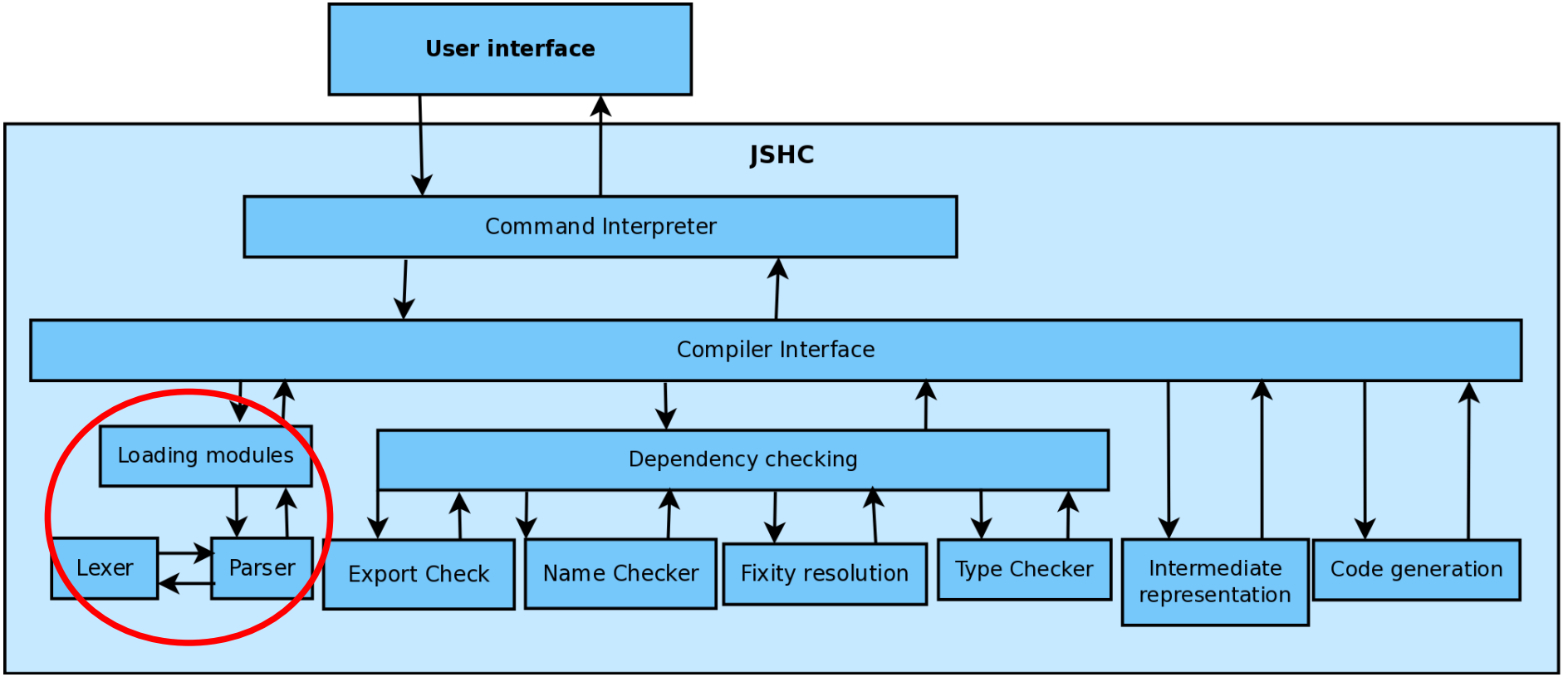
Hur fungerar JSHC?

Kommando tolkas



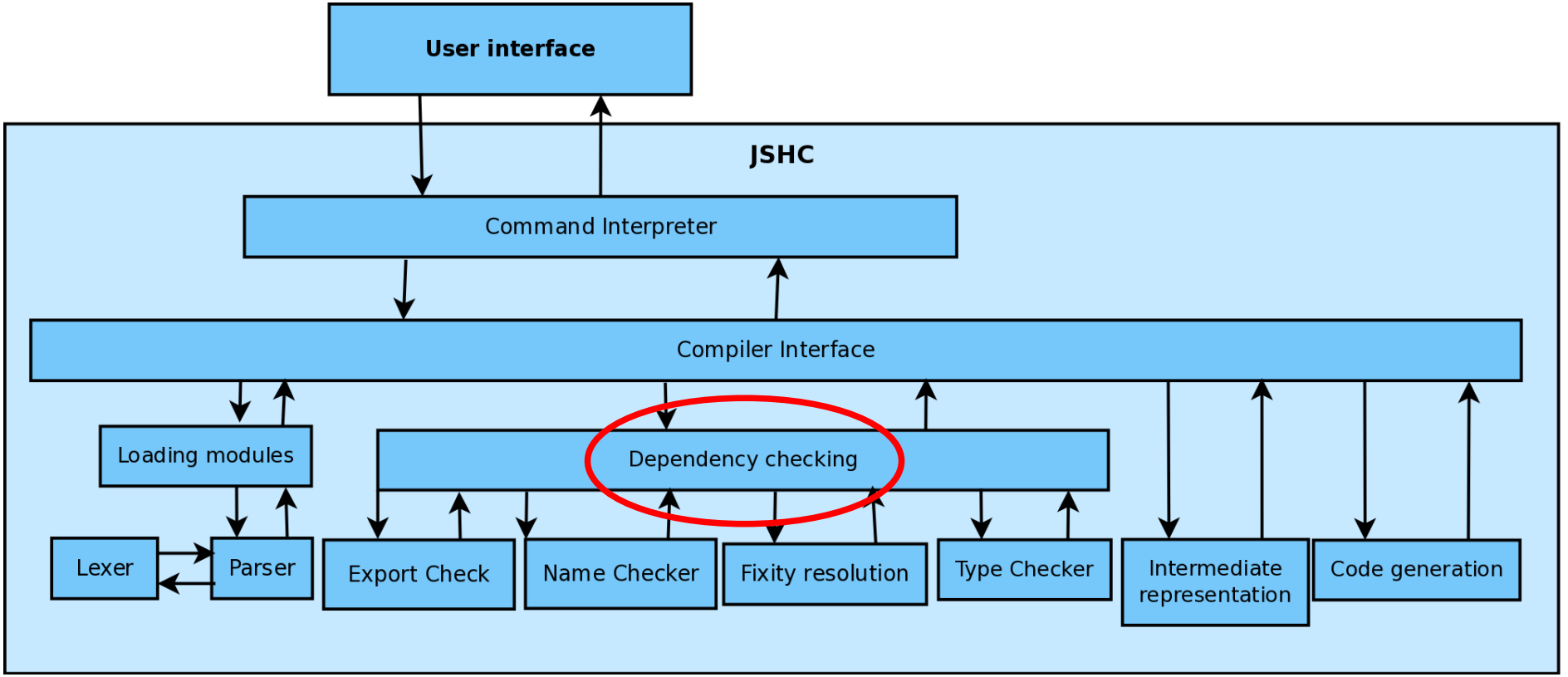
Hur fungerar JSHC?

Moduler laddas



Hur fungerar JSHC?

Dependency checking



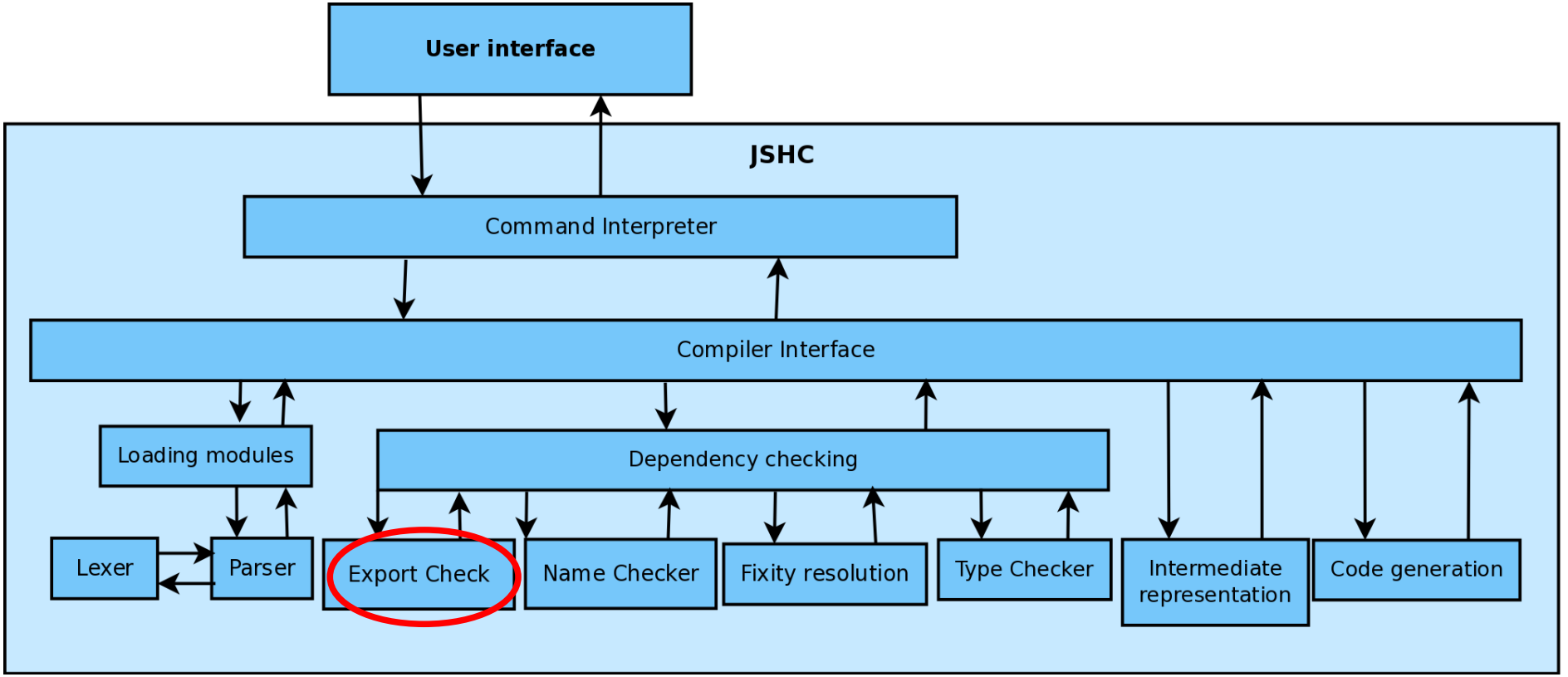
Dependency checking

```
even n = if n==0
   then True else odd (n-1)

odd = if n==0
   then False else even (n-1)
```

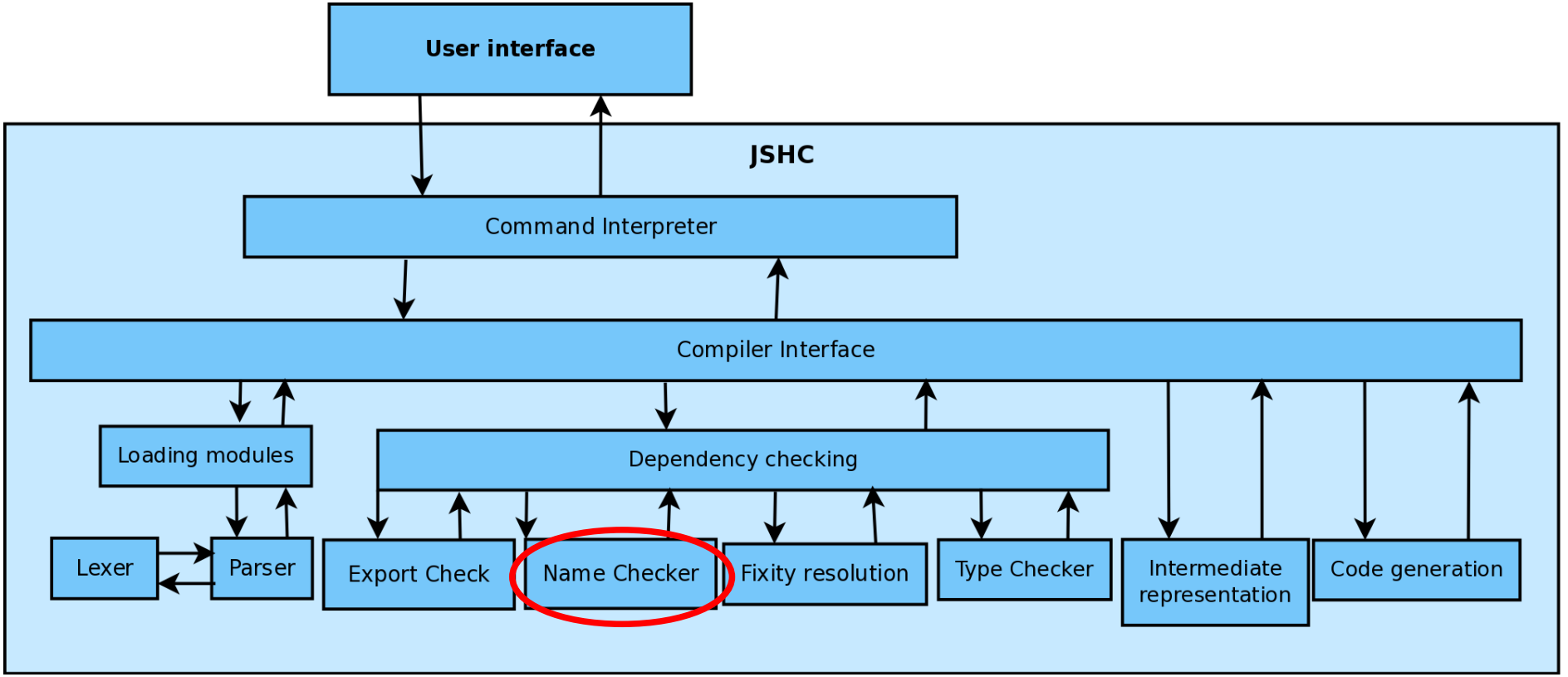
Hur fungerar JSHC?

Kontroll av exporter



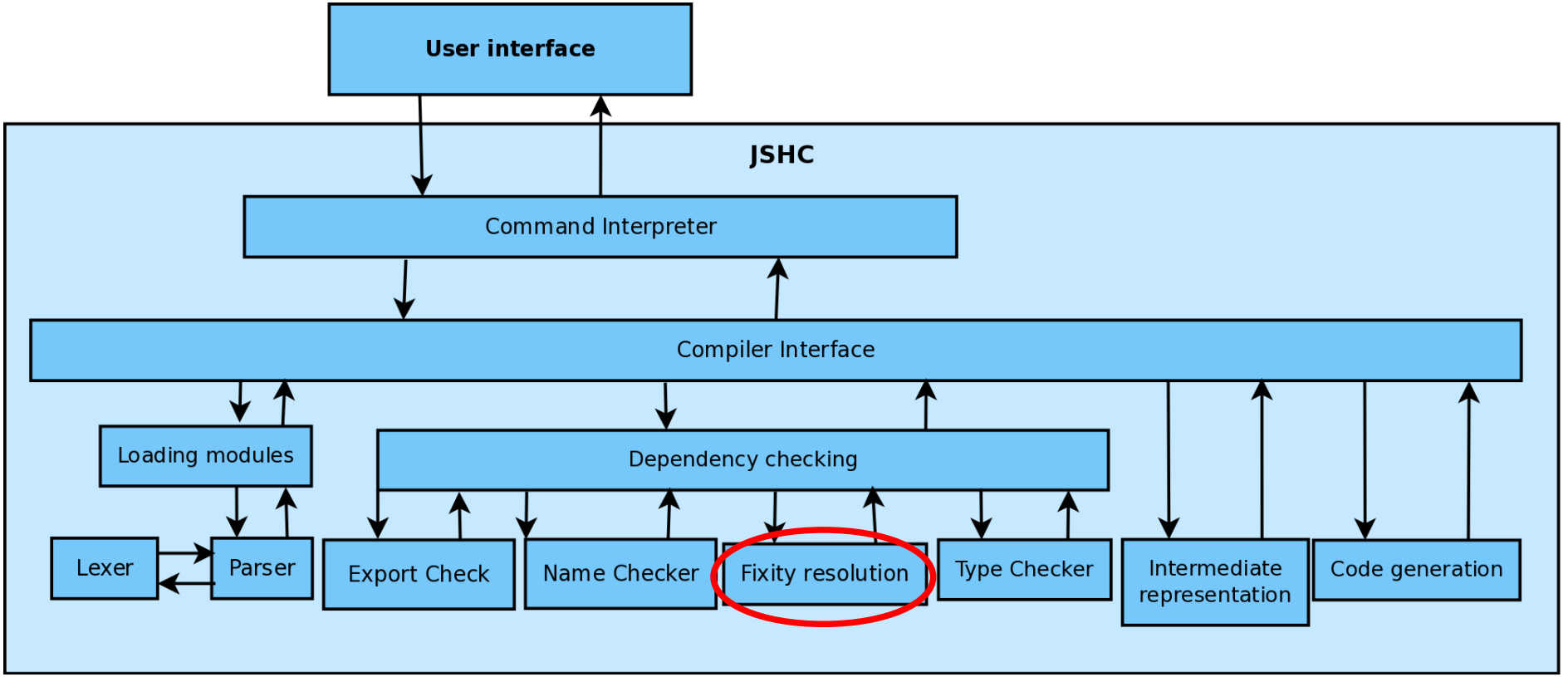
Hur fungerar JSHC?

Namnkontroll



Hur fungerar JSHC?

Operatorprecedens



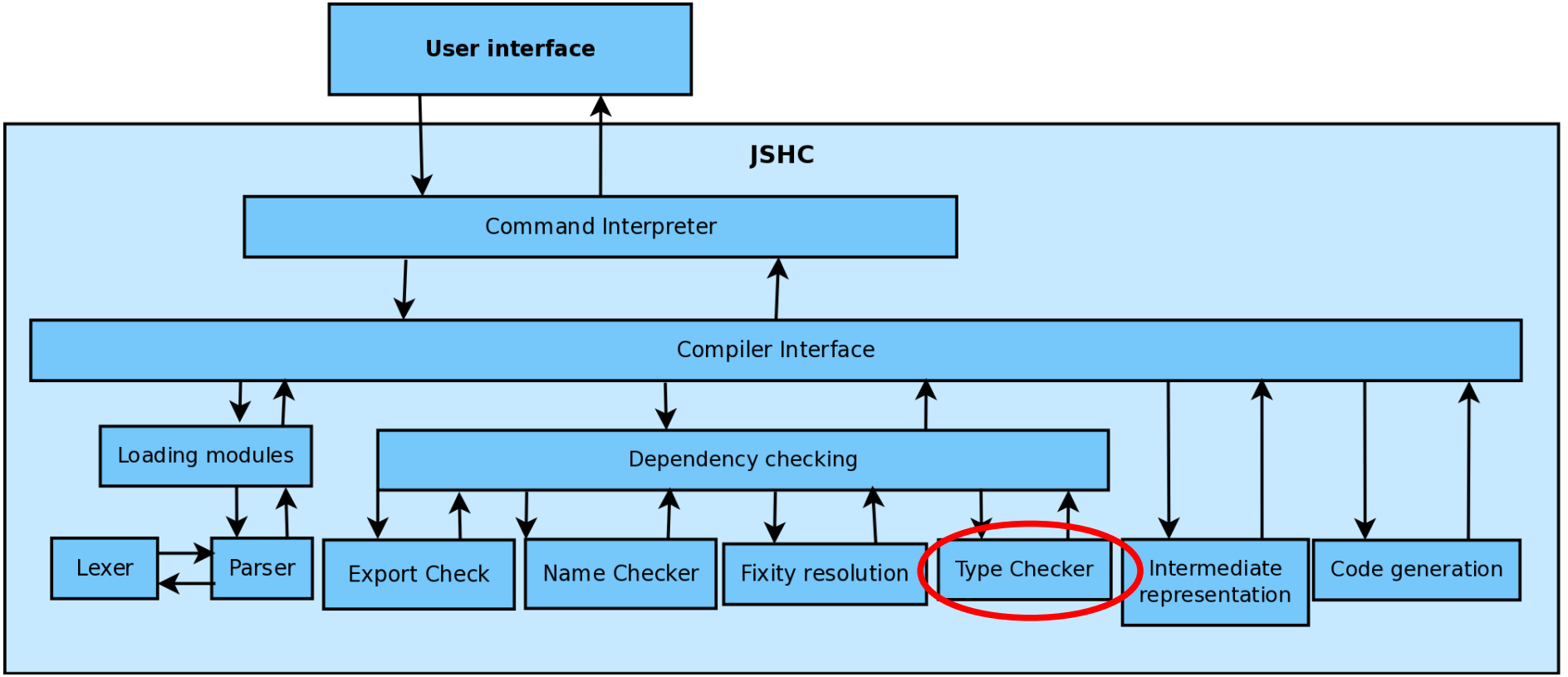
Operatorprecedens

```
infixl 7 *
infixl 6 +
x + y = ...
x * y = ...
```

```
2 * 10 + 3
```

Hur fungerar JSHC?

Typkontroll



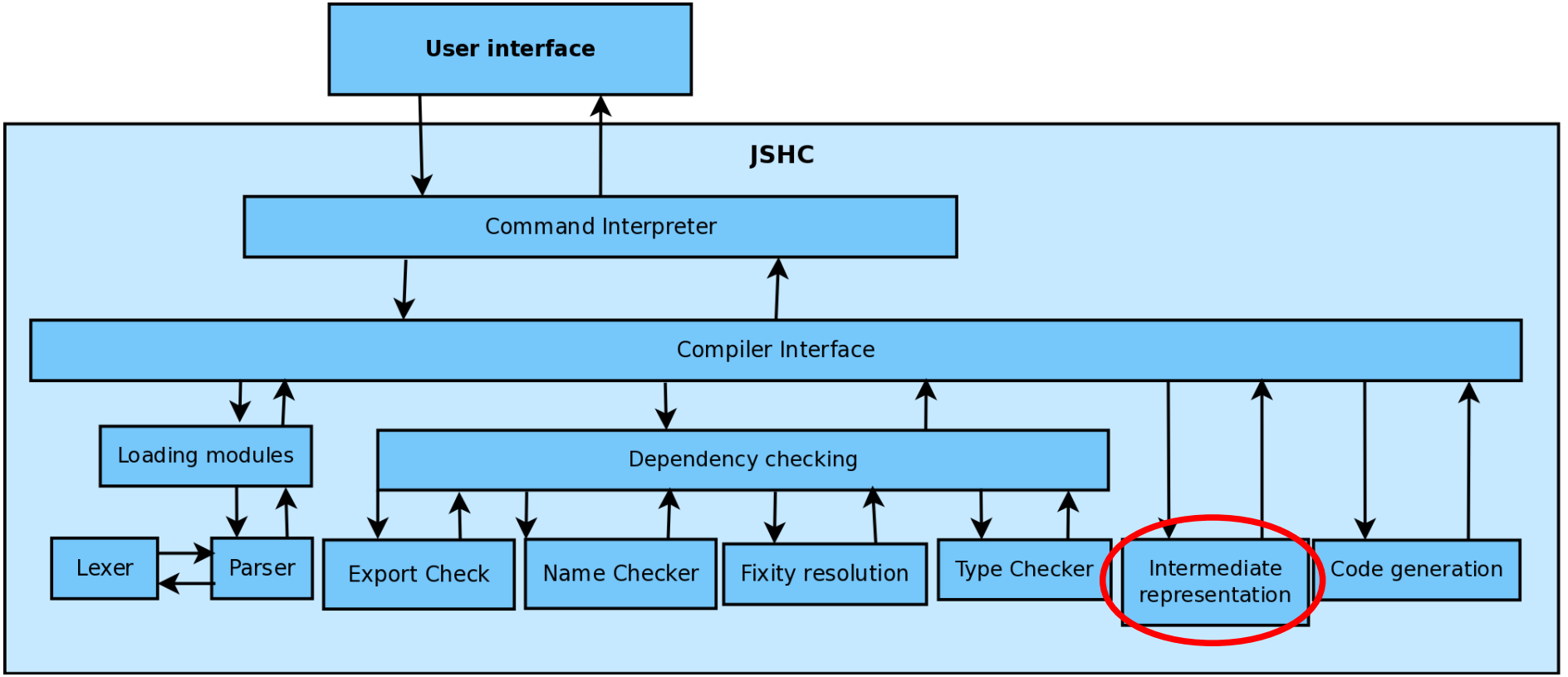
Typkontroll

```
map :: (a → b) → [a] → [b]

data Maybe a = Nothing | Just a
Maybe :: * → *
Nothing :: Maybe a
Just :: a → Maybe a
fromJust :: Maybe a → a
```

Hur fungerar JSHC?

Mellanrepresentation



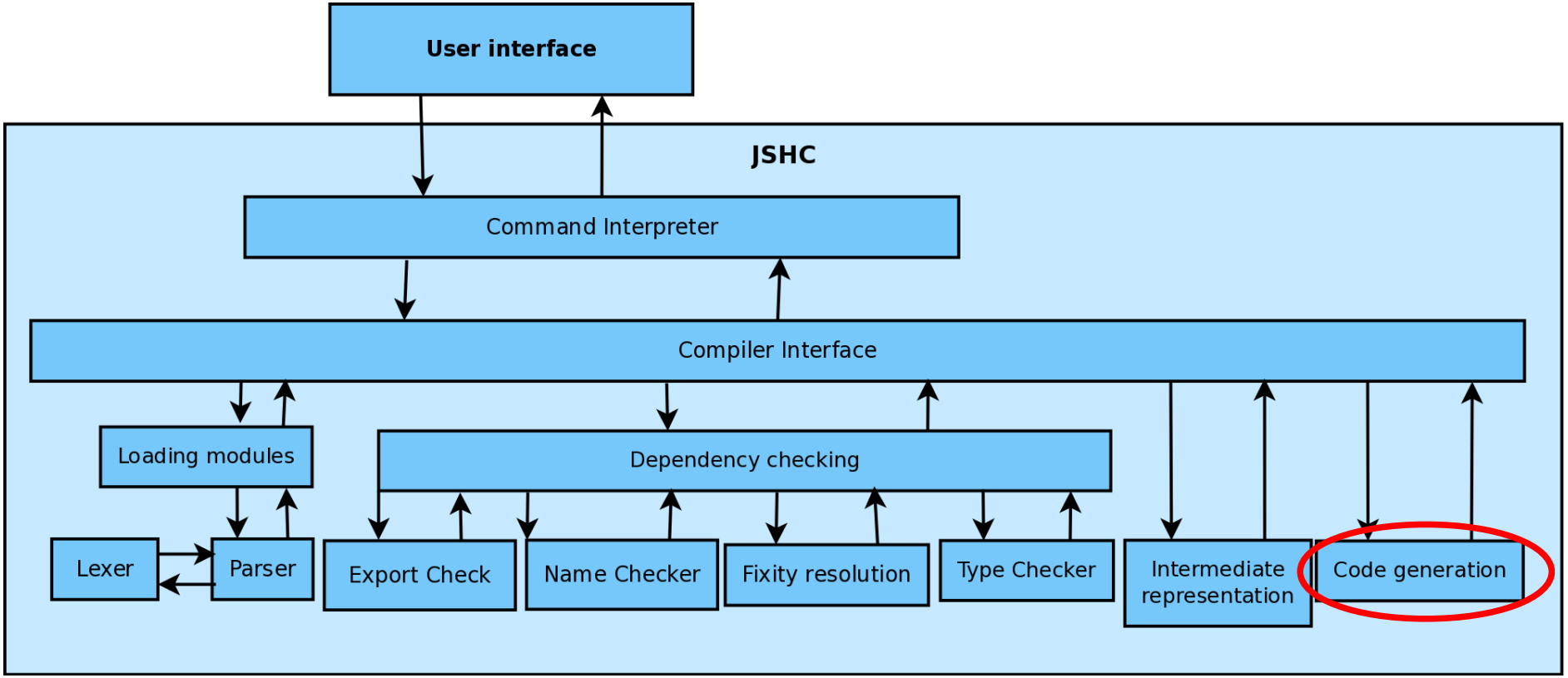
Mellanrepresentation

```
if a < b then a else b

case (<) a b of
  True → a
  False → b
```

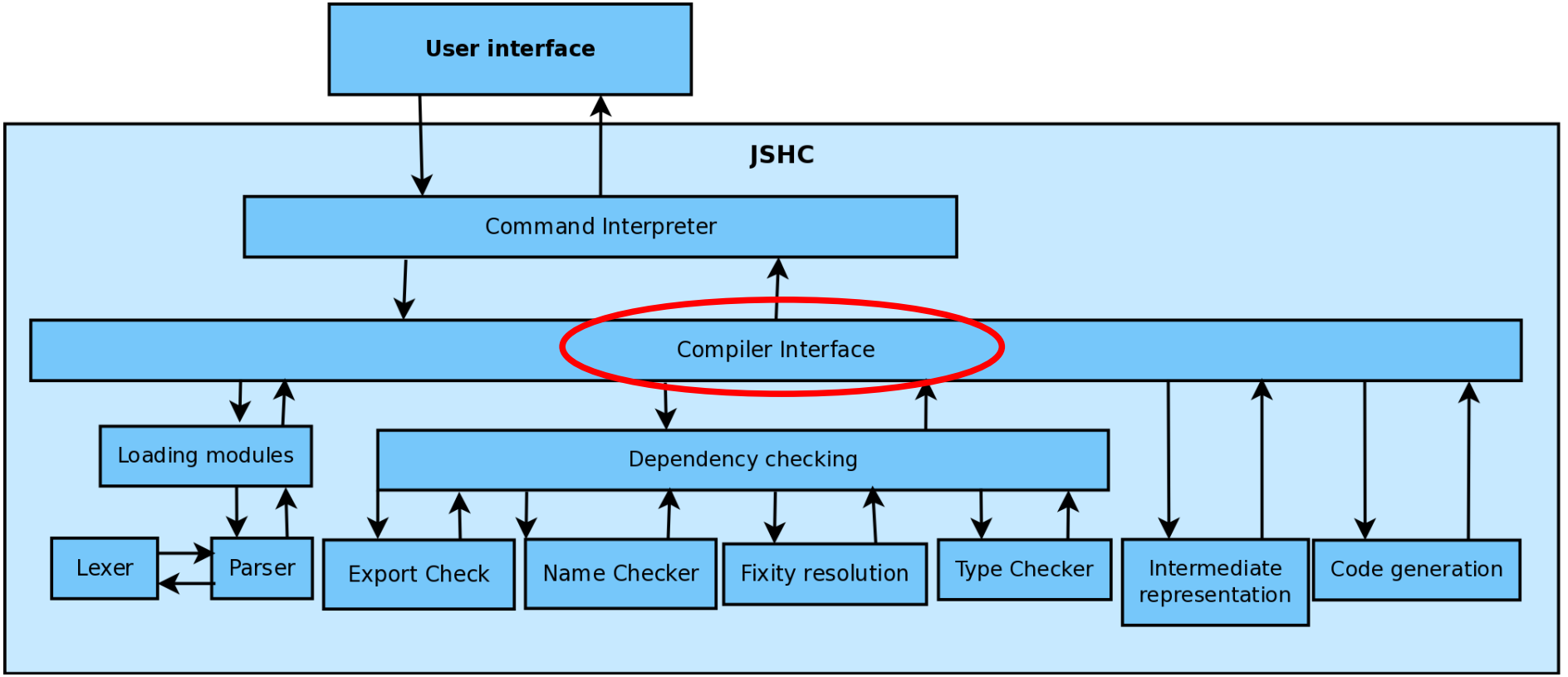
Hur fungerar JSHC?

Generera JavaScript



Hur fungerar JSHC?

Exekvera JavaScript



Problem vi stött på under arbetet

Problem vi stött på under arbetet

Projektets storlek

Problem vi stött på under arbetet

- Projektets storlek
  - Haskells storlek och komplexitet

Problem vi stött på under arbetet

Projektets storlek

- Haskells storlek och komplexitet
- Dynamisk typning

Problem vi stött på under arbetet

Projektets storlek
- Haskells storlek och komplexitet
- Dynamisk typning

Sinsemellan rekursiva moduler

I framtiden

I framtiden

Fylla ut syntaxen

I framtiden

Fylla ut syntaxen

Typklasser

Typklasser

```
(==) :: Eq a => a → a → Bool
(<)  :: Ord a => a → a → Bool
(*)  :: Num n => n → n → n
```

I framtiden

Fylla ut syntaxen

Typklasser

Foreign function interface

I framtiden

Fylla ut syntaxen

Typklasser

Foreign function interface

Sinsemellan rekursiva moduler

I framtiden

Fylla ut syntaxen

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Standardbibliotek