

`<script>` λ `</script>`

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?

Klientbaserade webbapplikationer
belastar servern mindre

Varför JavaScript?

JavaScript är de facto

standard för

klientbaserad skriptning

Varför JavaScript?

Den genererade koden
kan köras på klientsidan

Varför JavaScript?

Den genererade koden
kan köras på klientsidan

Koden kan genereras på klientsidan

Vad är JavaScript?

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Imperativt

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Imperativt

Objektorienterat

Vad är JavaScript?

Imperativt

Objektorienterat

Dynamiskt typat

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Imperativt

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Dynamiskt typat

Första klassens funktioner

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

2

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var posi = -1;
var words = new Array();
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function setVisible(visi){
    var x = document.getElementById("shadow");
    var t = document.getElementsByName("text")[0];
    x.style.position = "absolute";
    x.style.top = (findPosX(t)+3)+"px";
    x.style.left = (findPosX(t)+2)+"px";
    x.style.visibility = vis;
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{
    var curtop = 0;
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        curtop += obj.offsetTop;
        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;
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```
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 = mouseClicked;
    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;
}
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```
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 mouseClicked=function(){
    document.getElementsByName("text")[0].value = this.firstChild.nodeValue;
    setVisible("hidden");
    Posi = -1;
    oldins = this.firstChild.nodeValue;
}
```

Hitta typfelet!

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var suggestions = new Array("Boris", "Backer", "Peter", "Test", "Bums");
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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];
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    x.style.top = (findPosX(t)+3)+"px";
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        }
    }
    else if (obj.y){
        curtop += obj.y;
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    }
    return curtop;
}
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function lookAt(){
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    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;
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    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){
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var mouseHandlerOut=function(){
    this.style.background = "white";
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}
var mouseClicked=function(){
    document.getElementsByName("text")[0].value = this.firstChild.nodeValue;
    setVisible("hidden");
    Posi = -1;
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}
```

Klipp och klistra

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    return curtop;
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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){
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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){
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                else input = textfield.value;
                setColor(++posi, "blue", "white");
                textfield.value = outp.childNodes[posi].firstChild.nodeValue;
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                    setColor(posi, "#fff", "black");
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                    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

Osäkert gränssnitt

En annan lösning:

Översätt!

Varför just Haskell?

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- Vi är Haskellprogrammerare!
 - Använda redan existerande kod

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- Vi är Haskellprogrammerare!
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- Stark statisk typning
- Modulsystem
- Lat evaluering
ones = 1:ones

Möjligheter att använda Haskell för
webprogrammering finns redan

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Serverramverk

- Happstack
- Yesod

Möjligheter att använda Haskell för webprogrammering finns redan

Serverramverk

- Happstack
- Yesod

Kompilatorer till JavaScript

- GHCjs
- UHC



Nu är det dags
för demon!

Kompilering: en översikt

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Tre steg

Kompilering: en översikt

Tre steg

- Abstrakt representation

Kompilering: en översikt

Tre steg

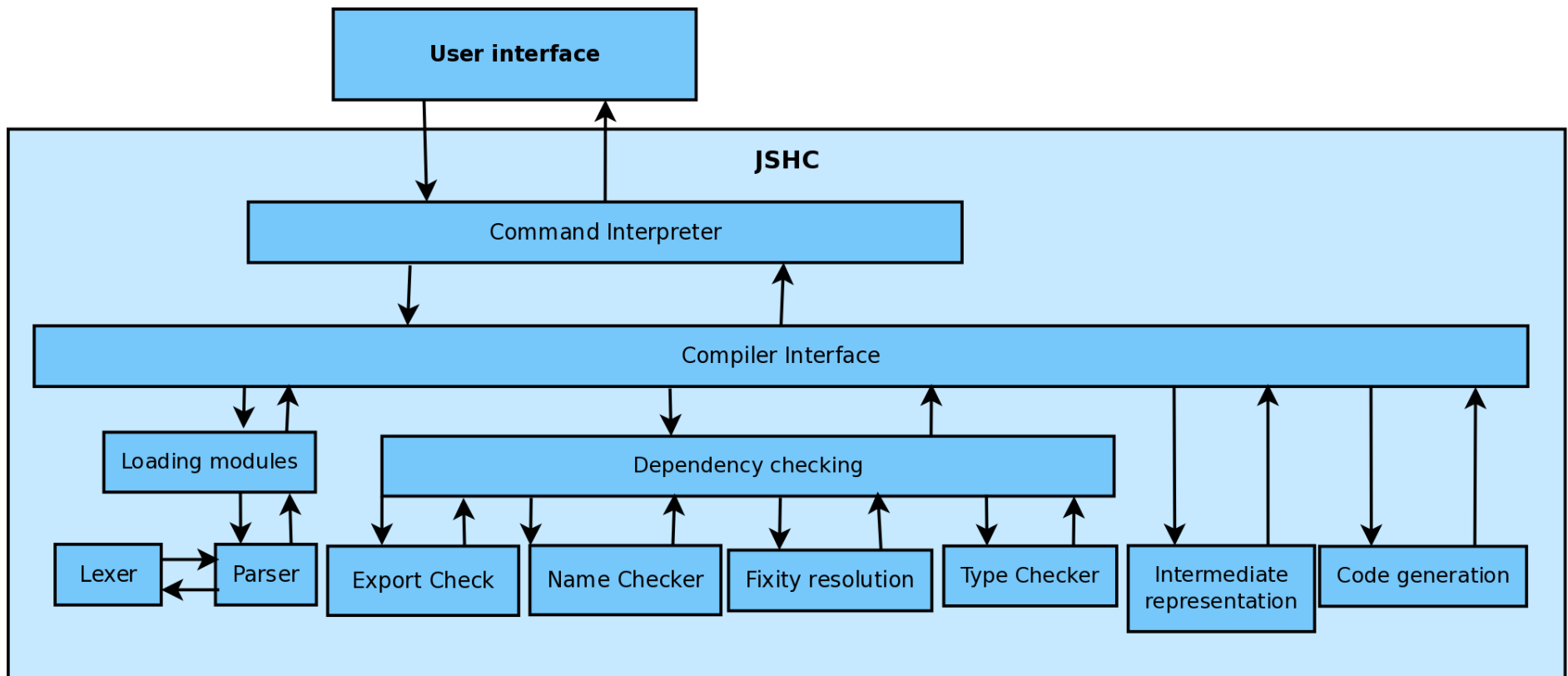
- Abstrakt representation
- Kontroll av representation

Kompilering: en översikt

Tre steg

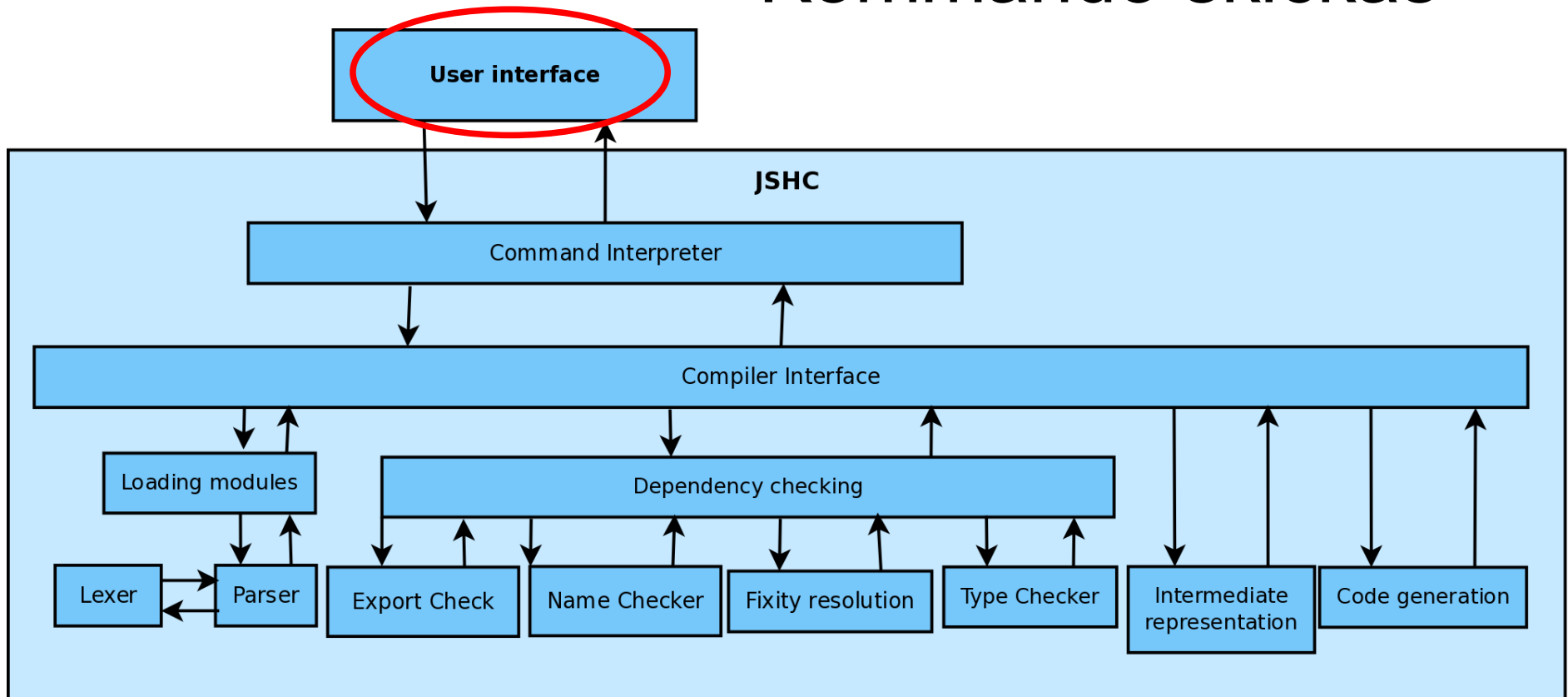
- Abstrakt representation
- Kontroll av representation
- Generering av målrepresentation

Hur fungerar JSHC?



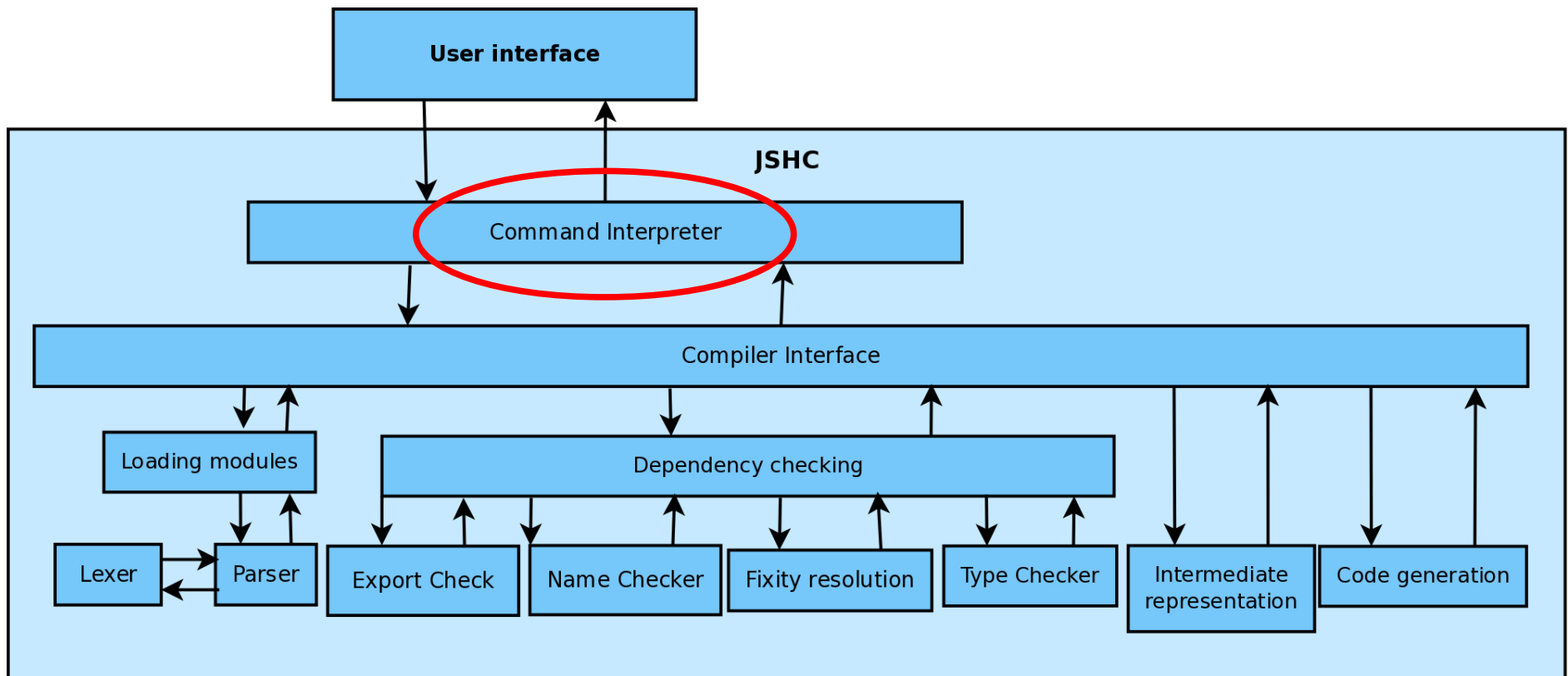
Hur fungerar JSHC?

Kommando skickas



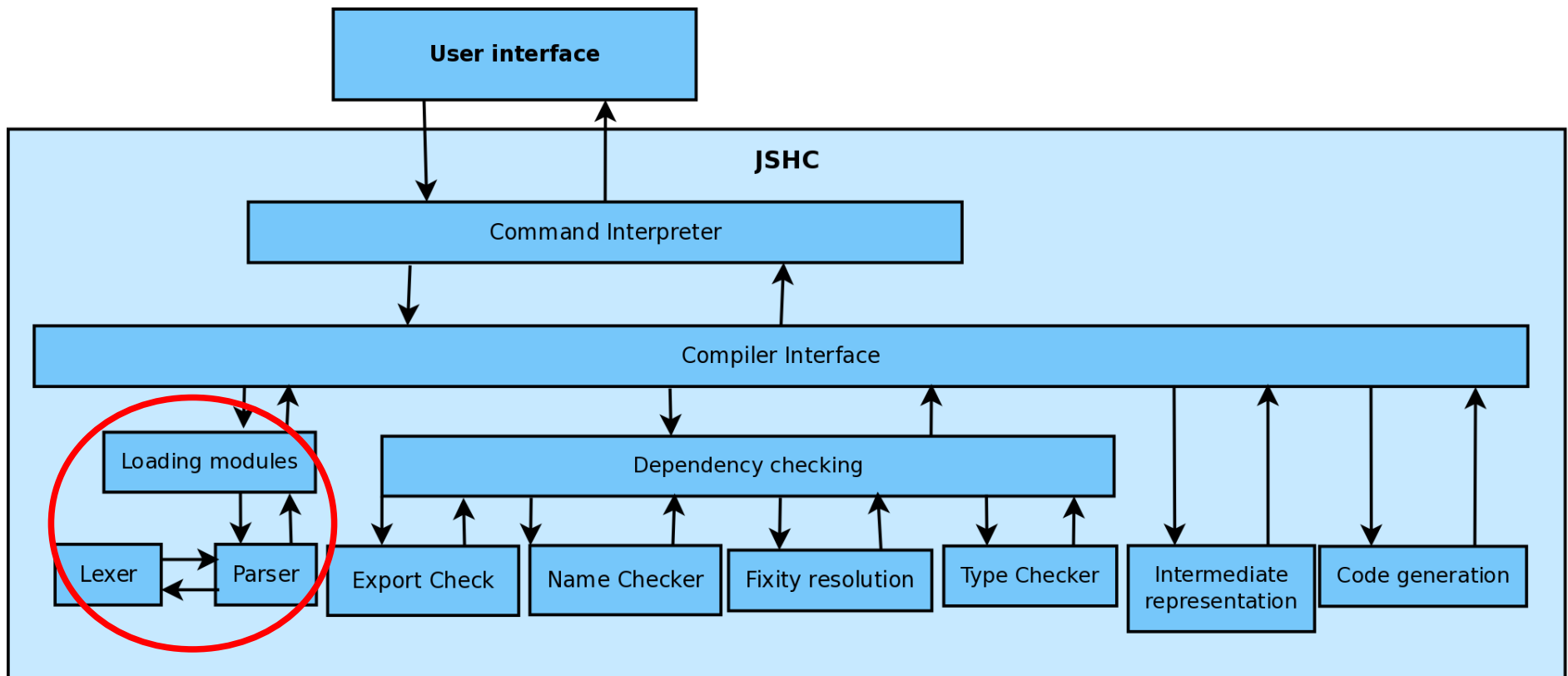
Hur fungerar JSHC?

Kommando tolkas



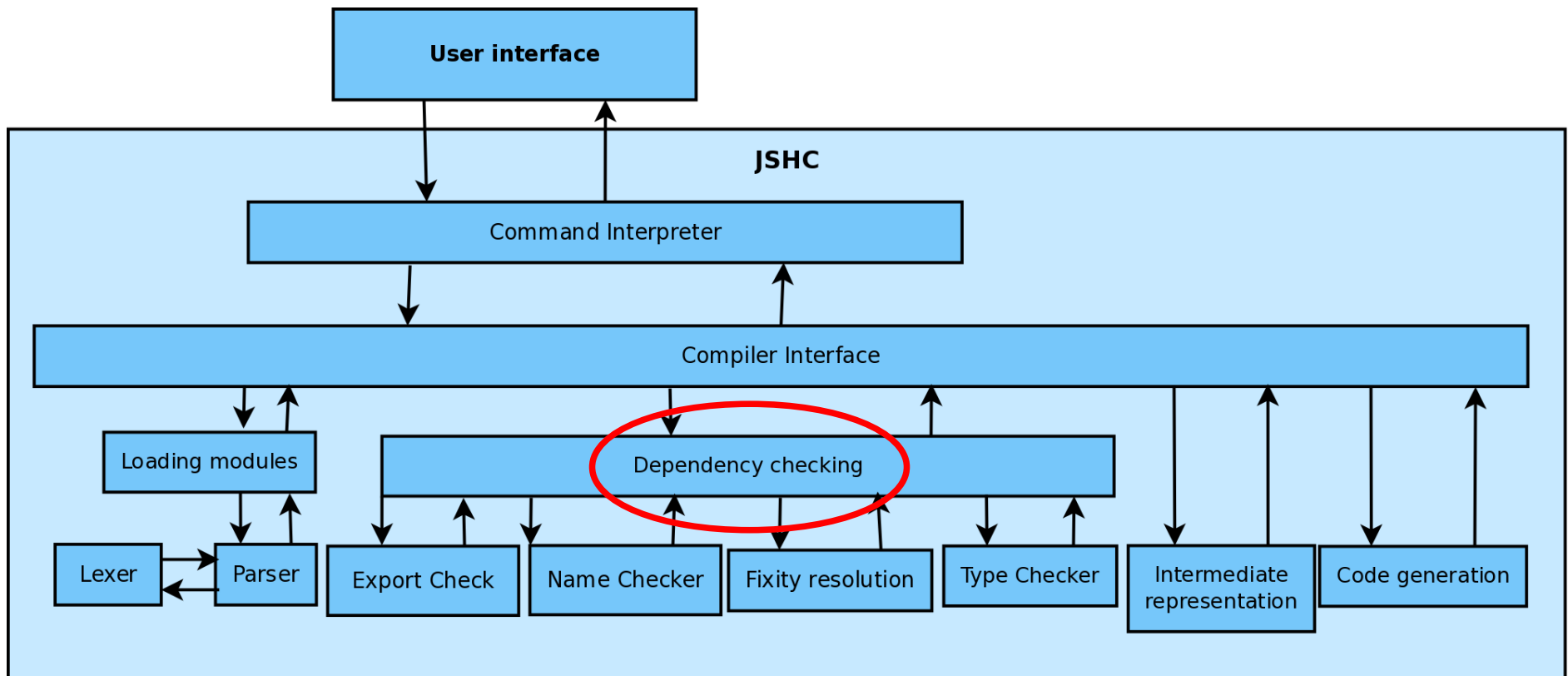
Hur fungerar JSHC?

Moduler laddas

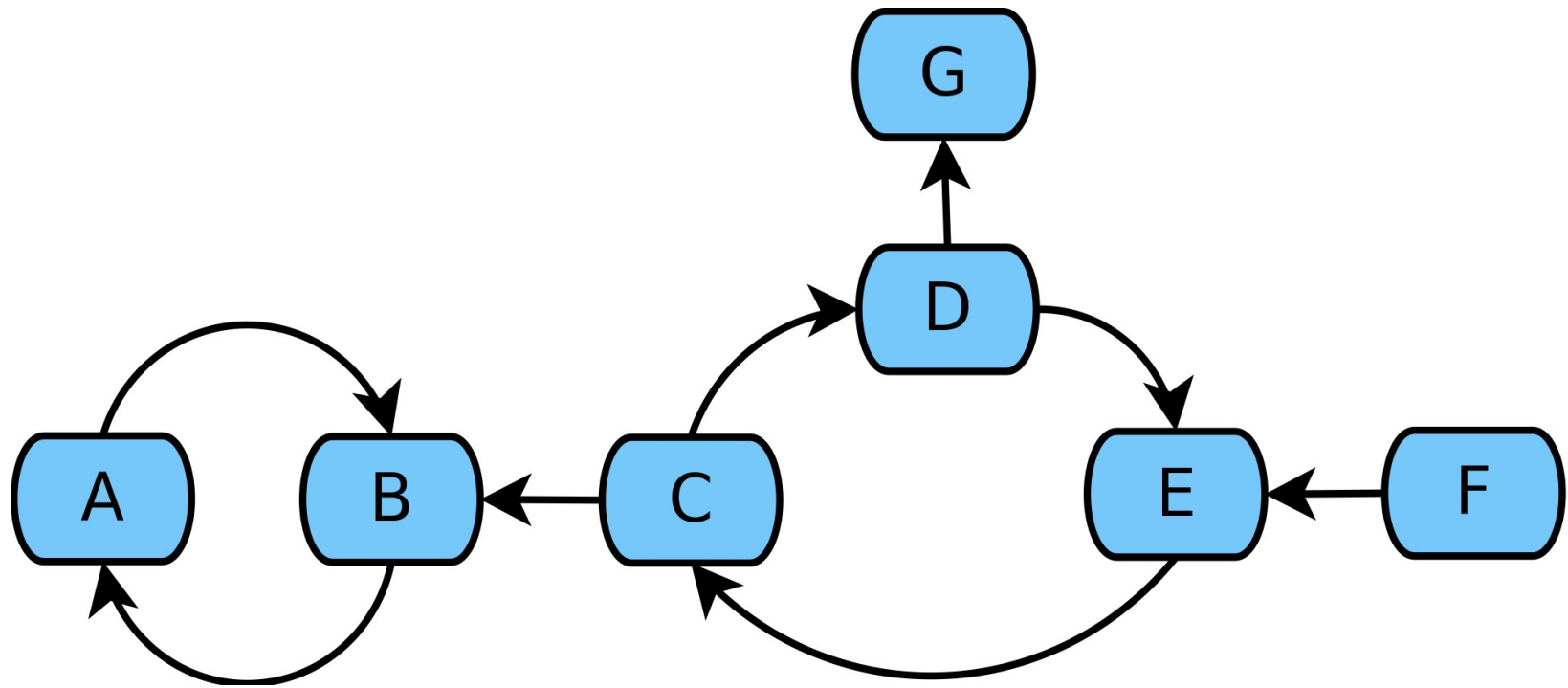


Hur fungerar JSHC?

Dependency checking

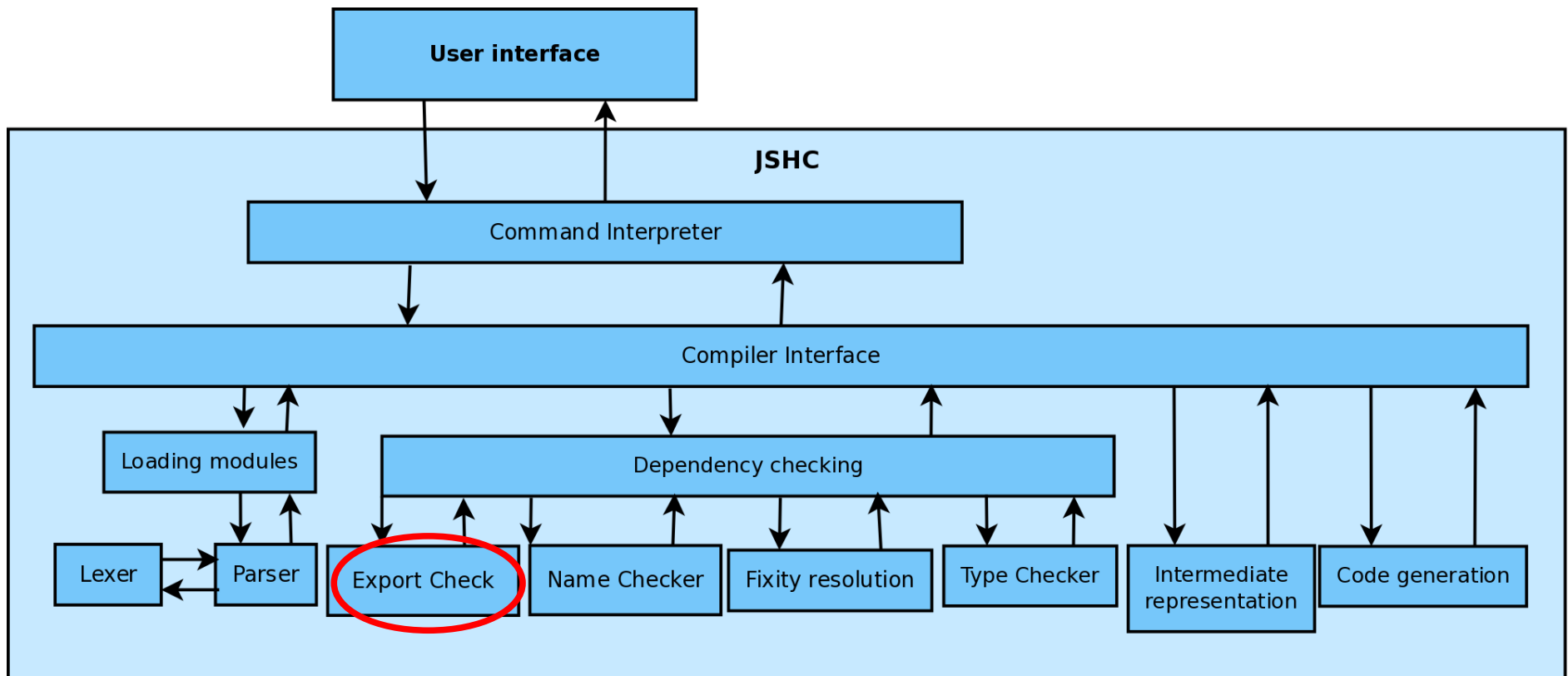


Dependency checking



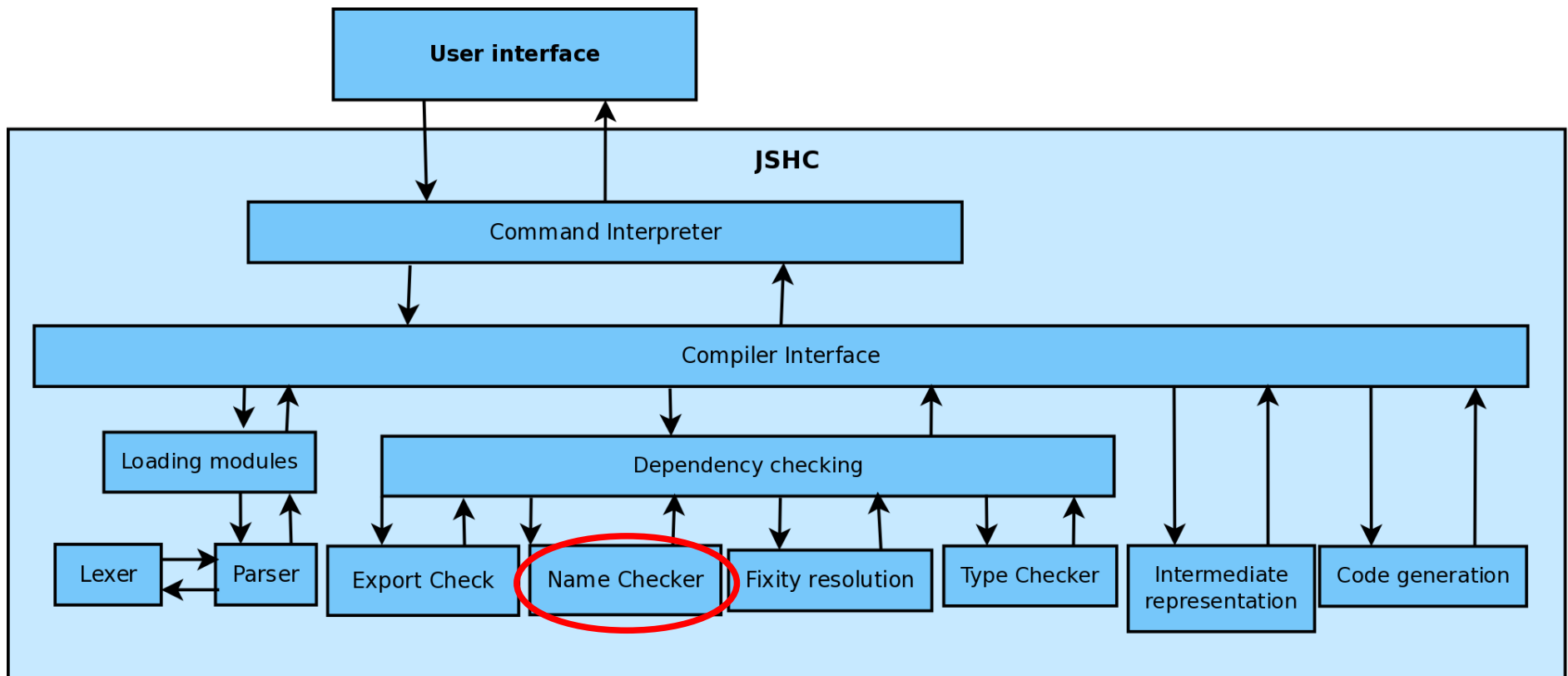
Hur fungerar JSHC?

Kontroll av exporter



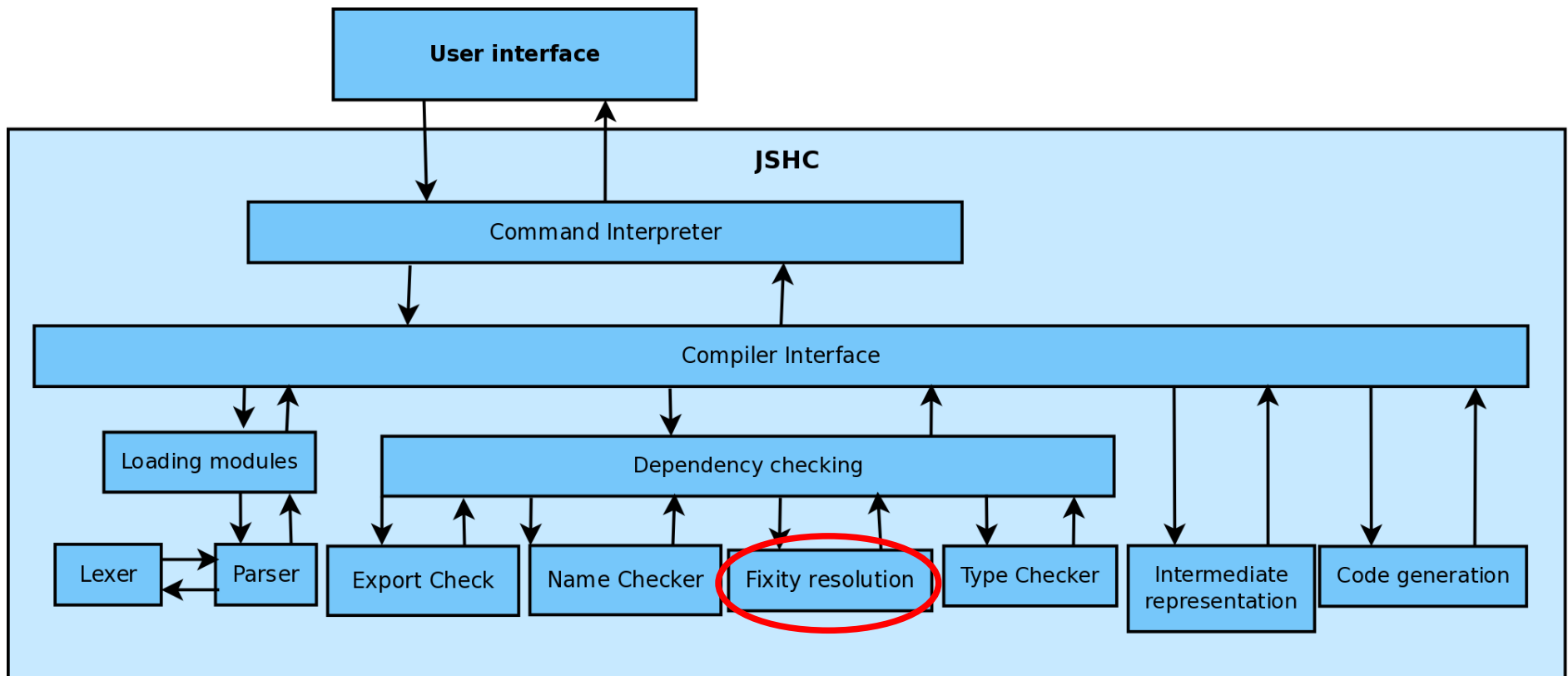
Hur fungerar JSHC?

Namnkontroll



Hur fungerar JSHC?

Operatorprecedens



Operatorprecedens

infixl 7 *

infixl 6 +

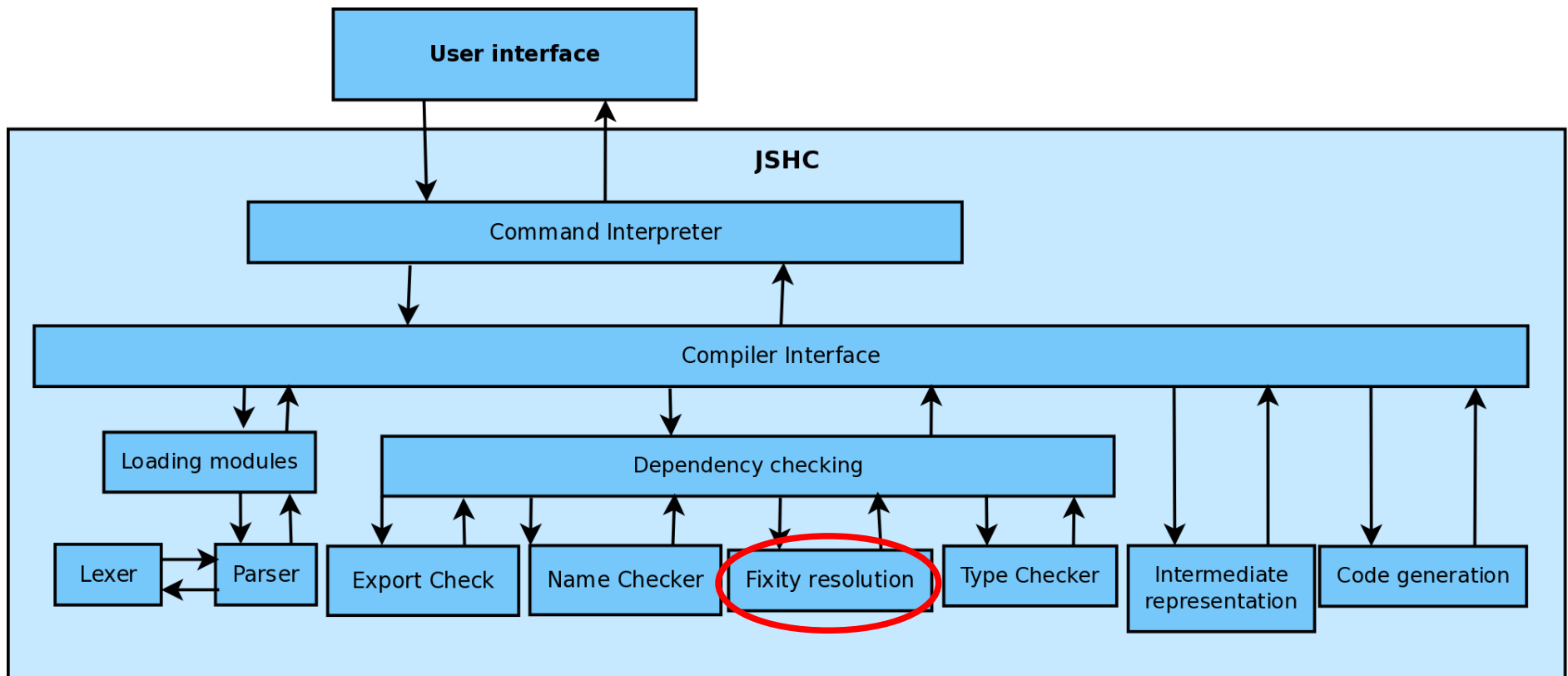
x + y = ...

x * y = ...

2 * 10 + 3

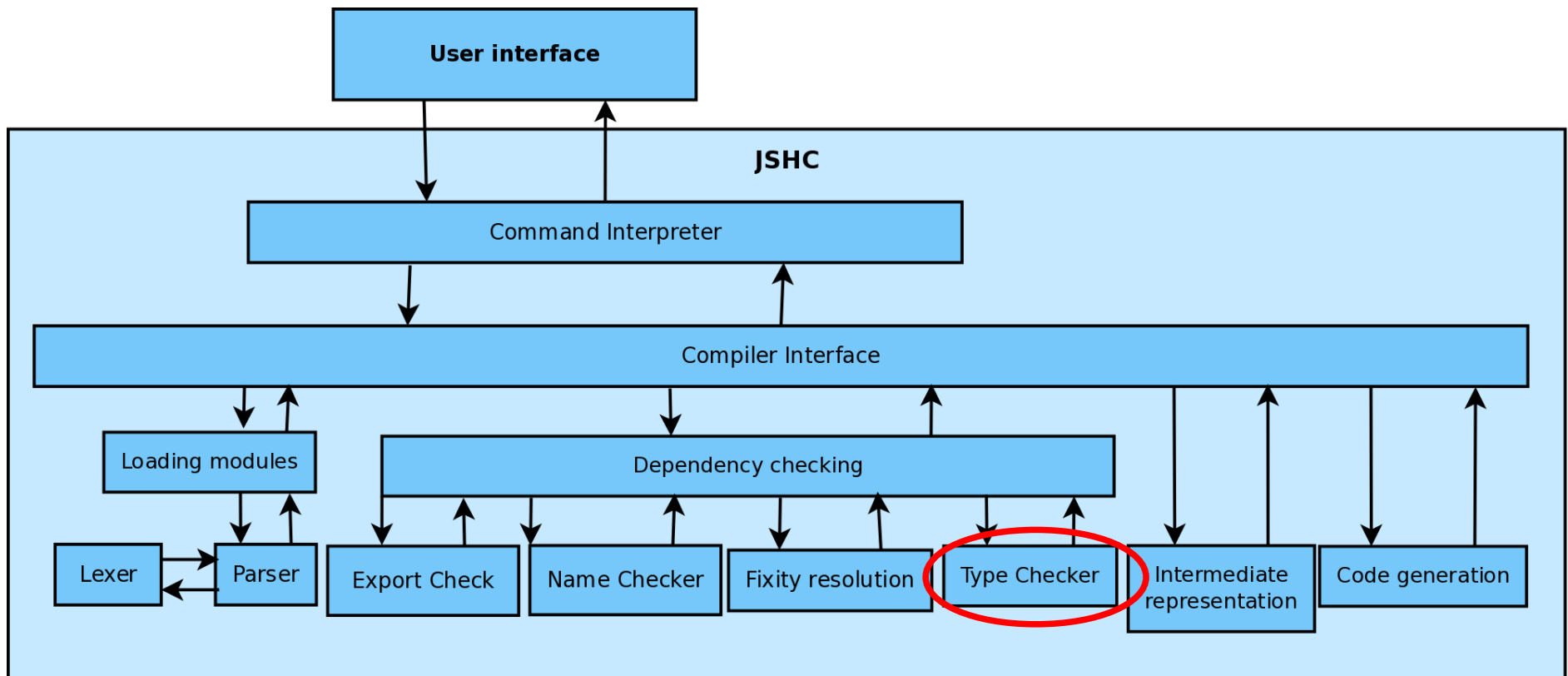
Hur fungerar JSHC?

Operatorprecedens



Hur fungerar JSHC?

Typkontroll



Typkontroll

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

Typkontroll

`map :: (a → b) → [a] → [b]`

`data Maybe a = Nothing | Just a`

`Maybe :: * → *`

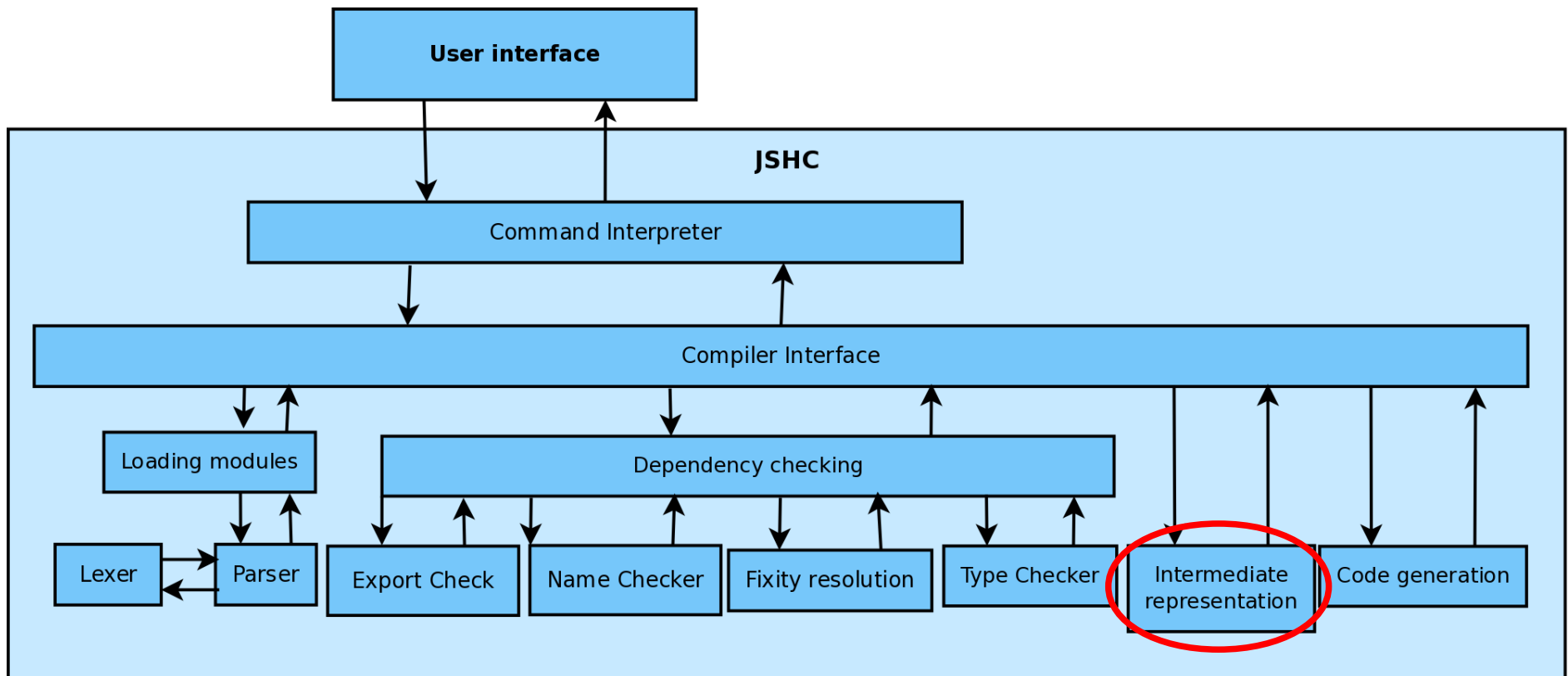
`Just :: a → Maybe a`

`Maybe Int` `[Int]`

`Maybe Maybe` `[[]]`

Hur fungerar JSHC?

Mellanrepresentation



Mellanrepresentation

if a < b then a else b

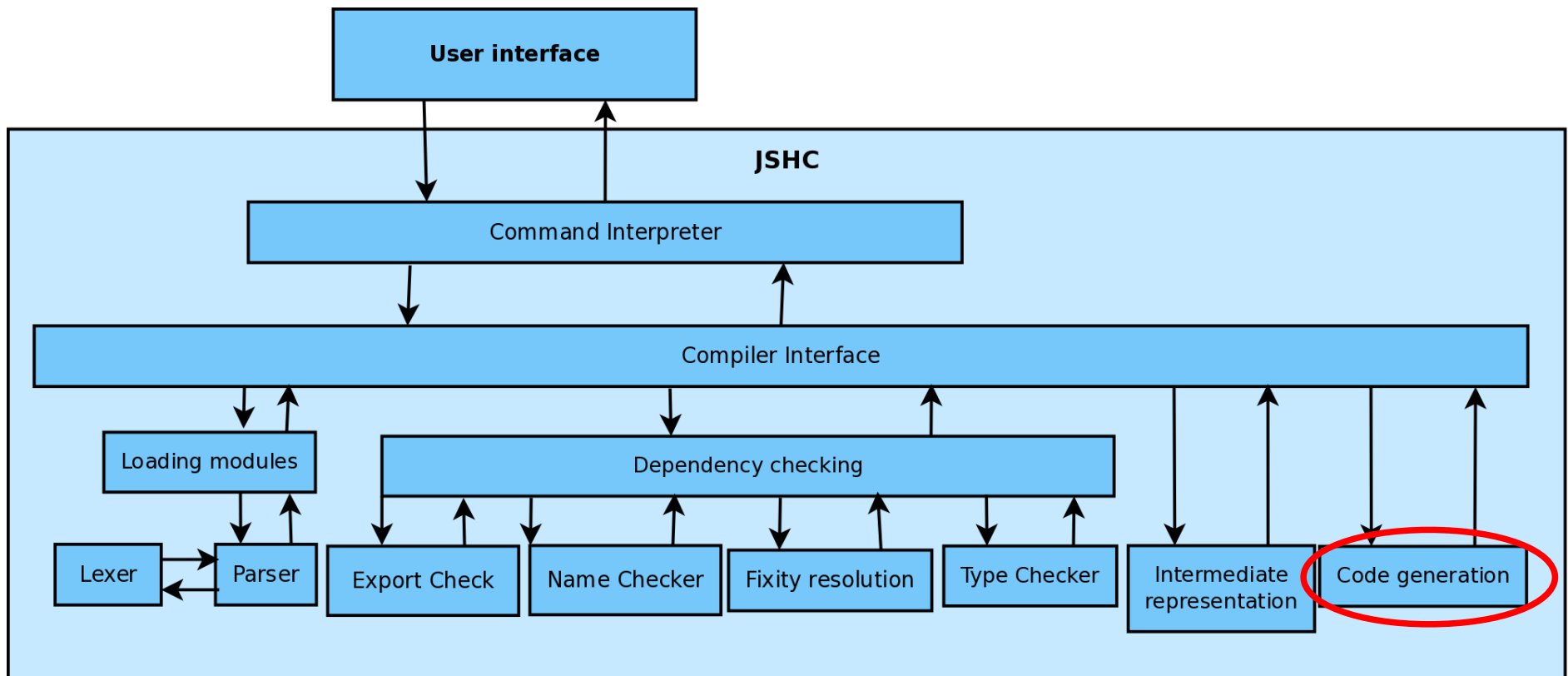
case (<) a b of

True → a

False → b

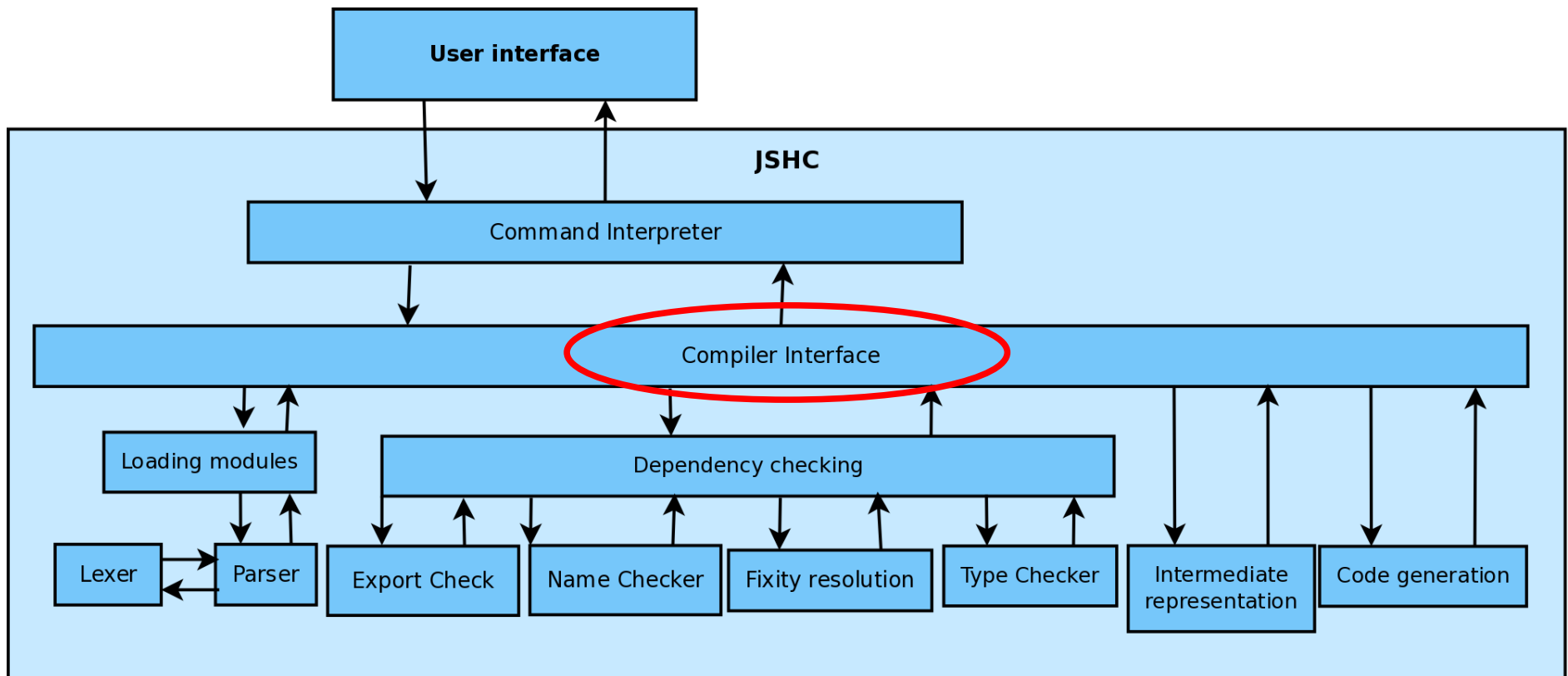
Hur fungerar JSHC?

Generera JavaScript



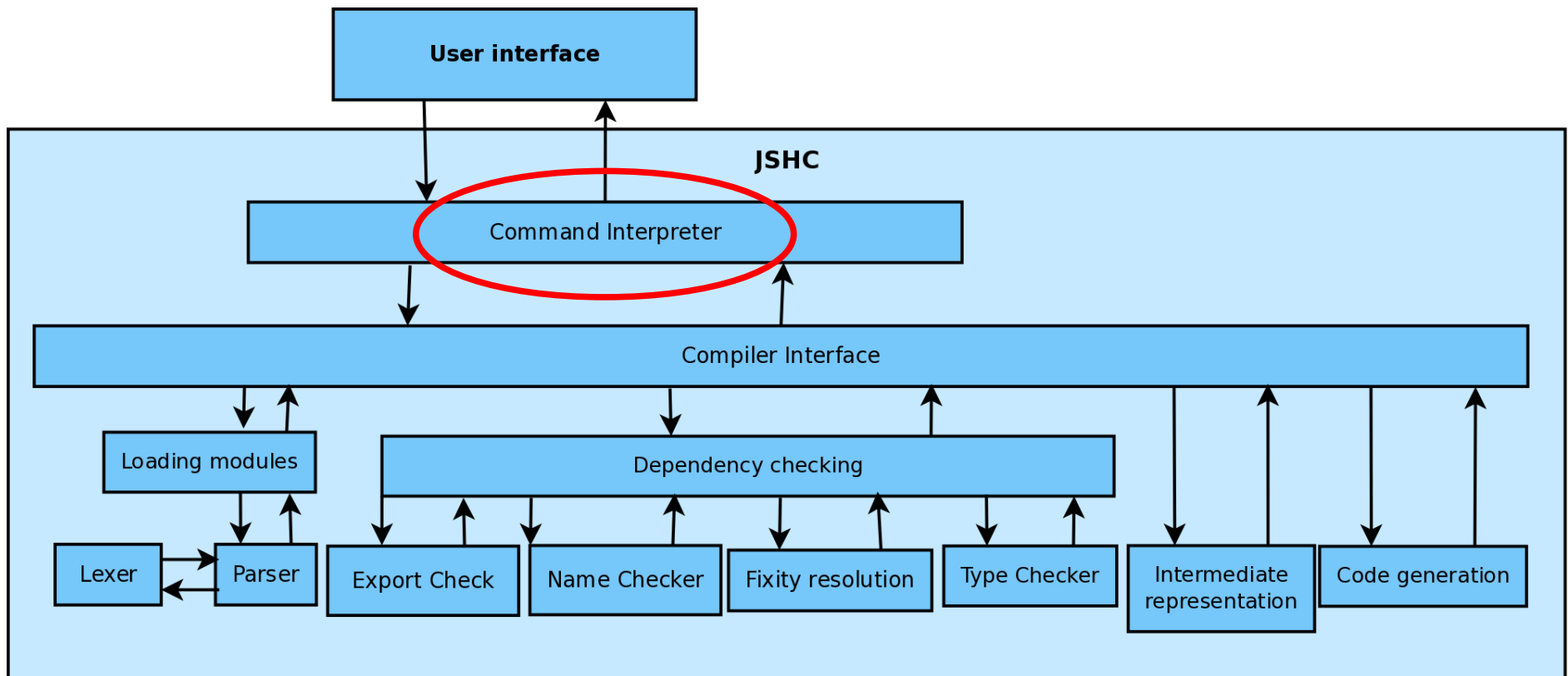
Hur fungerar JSHC?

Exekvera JavaScript



Hur fungerar JSHC?

Kommando tolkas



Problem vi stött på
under arbetet

Problem vi stött på under arbetet

Projektets storlek

Problem vi stött på under arbetet

Projektets storlek

- Haskell's storlek och komplexitet

Problem vi stött på under arbetet

Projektets storlek

- Haskell's storlek och komplexitet
- Dynamisk typning

Problem vi stött på under arbetet

Projektets storlek

- Haskell's storlek och komplexitet
- Dynamisk typning

Sinsemellan rekursiva moduler

I framtiden



I framtiden

Typklasser



I framtiden
Fylla ut syntaxen
Typklasser
Foreign function interface



I framtiden

Typklasser

Foreign function interface

Sinsemellan rekursiva moduler



I framtiden

Typklasser

Foreign function interface

Sinsemellan rekursiva moduler

Mindre utökningar av syntaxen



I framtiden

Typklasser

Foreign function interface

Sinsemellan rekursiva moduler

Mindre utökningar av syntaxen

Standardbibliotek



