2D Syntax

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`#lang 2d` package: `2d-test`

The `2d` language installs `#2d` reader support in the readtables, and then chains to the reader of another language that is specified immediately after `2d`.

The `#2d` syntax extension adds the ability use a two-dimensional grid syntax. That is, you can draw an ASCII-art grid and then treat that as an expression. For example, here is a simple equality function that operates on pairs and numbers, written using a `#2d` conditional expression:

```
#lang 2d racket
(require 2d/cond)

(define (same? a b)
  #2dcond
  ╔═══════════╦═══════════════════╦═══════════╗
  ║           ║     (pair? a)     ║ (number? a) ║
  ╠═══════════╬═══════════════════╬═══════════╣
  ║ (pair? b) ║ (and (same? (car a)  ║    #f     ║
  ║           ║              (car b))  ║           ║
  ║           ║      (same? (cdr a)  ║           ║
  ║           ║             (cdr b))) ║           ║
  ╠═══════════╬═══════════════════╬═══════════╣
  ║ (number? b) ║        #f         ║  (= a b)  ║
  ╚═══════════╩═══════════════════╩═══════════╝)
```

This notation works in two stages: reading, and parsing (just as in Racket in general). The reading stage converts anything that begins with `#2d` into a parenthesized expression (possibly signaling errors if the ═ and ║ and ╬ characters do not line up in the right places).

Since the first line contains `#2dcond`, the reader will produce a sequence whose first position is the identifier `2dcond`.

That macro will take over and then expand into ordinary conditional expressions, in this case figuring out whether or not the inputs are pairs or numbers and evaluating the code in the appropriate cell.

At the reader level, the syntax `#2d` notation checks the number of columns in the first row and uses that as a guide for where subsequent rows may appear. Once that first row is set, it serves as a guide to where the columns may appear in subsequent rows, although following columns may be merged.

This merging can simplify some uses of `#2d` expressions. For example, consider this expression that captures subtyping relationships between a few of the Typed Racket numeric types, this time using a `#2d` match expression:

```
#lang 2d racket
(require 2d/match)

(define (subtype? a b)
  #2dmatch
  ╔═══════════╦═══════════╦═══════╦═══════════╗
  ║   a  b    ║ 'Integer  ║ 'Real ║ 'Complex  ║
  ╠═══════════╬═══════════╩═══════╩═══════════╣
  ║ 'Integer  ║             #t                ║
  ╠═══════════╬═══════════╗                   ║
  ║ 'Real     ║           ╠═══════╗           ║
  ╠═══════════╣           ╚═══════╬═══════════╣
  ║ 'Complex  ║         #f        ║           ║
  ╚═══════════╩═══════════════════╩═══════════╝)
```

There are a number of cell walls missing here, but this is still a well-formed `#2d` expression. In this case, the `2dmatch` treats any of the situations that fall into the larger regions as the same.

In general, a `#2d` expression, when read, turns into an expression with at least two sub-pieces (not counting the initial name). The first is a sequence of numbers giving the widths of the top row of cells; the second is also a sequence of numbers, this time giving the heights of the leftmost column of cells. The remaining sequence describe the cells content. The first element of each is itself a sequence of coordinates, one for each of the cells that are connected together. The remaining elements are the subexpressions in the given cells.

For example, this:

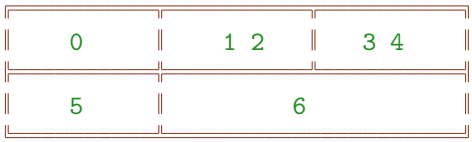
```
#lang 2d racket
'#2dex
╔═══╦═══╗
║ 0 ║ 1 ║
╠═══╬═══╣
║ 2 ║ 3 ║
```

evaluates to

```
'(2dex (10 10)
       (2 2)
       (((0 0)) 0)
       (((0 1)) 2)
       (((1 0)) 1)
       (((1 1)) 3))
```

and this

```
#lang 2d racket
'#2dex
```



evaluates to

```
'(2dex (10 10 10)
       (2 2)
       (((0 0)) 0)
       (((0 1)) 5)
       (((1 0)) 1 2)
       (((1 1) (2 1)) 6)
       (((2 0)) 3 4))
```

In addition, the cells coordinates pairs have source locations of the first character that is inside the corresponding cell. (Currently the span is always 1, but that may change.)

1 Editing 2D

DrRacket provides a number of keybindings to help editing `#2d` expressions. See DrRacket's keyboard shortcuts.

2 2D Cond

```
(require 2d/cond)
```
package: 2d-lib

```
(2dcond cond-content)

 cond-content = question-row
                body-row
                ⋮
              | question-row
                body-row
                ⋮
                else-row

 question-row = empty-cell question-cell ···
              | empty-cell question-cell ··· else-cell

     body-row = question-cell exprs-cell ···

     else-row = question-cell exprs-cell ··· else-cell

question-cell = ╔═══════════════╗
                ║question-expr  ║
                ╚═══════════════╝

   empty-cell = ╔═══╗
                ║   ║
                ╚═══╝

   exprs-cell = ╔═══════════════╗
                ║expr expr ...  ║
                ╚═══════════════╝

    else-cell = ╔═══════╗
                ║ else  ║
                ╚═══════╝
```

Evaluates the first row of question expressions until one of them returns a true value (signaling an error if none do), then evaluates the first column of question expressions until one of them returns a true value (signaling an error if none do), and then evaluates the cell in the middle where both point to, returning the result of the last expression in that cell.

3 2D Match

```
(require 2d/match)
```
package: 2d-lib

```
(2dmatch match-content)

  match-content = match-first-row
                  match-row
                  ⋮

match-first-row = two-expr-cell match-pat-cell ···

      match-row = match-pat-cell exprs-cell ···

  two-expr-cell = ╔═══════════════════╗
                  ‖col-expr row-expr‖
                  ╚═══════════════════╝

 match-pat-cell = ╔═══╗
                  ‖ pat ‖
                  ╚═══╝

     exprs-cell = ╔═══════════════╗
                  ‖expr expr ...‖
                  ╚═══════════════╝
```

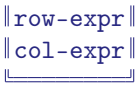
Matches `col-expr` against each of patterns in the first column of the table and matches `row-expr` against each of the patterns in the row row, and then evaluates the corresponding *exprs-cell*, returning the value of the last expression in that cell.

Within the top-left cell, the leftmost expression will count as `col-expr`, and the rightmost as `row-expr`. In case of a tie (i.e., both expressions start at the same column, but on different lines), the bottommost one will count as `col-expr`. For example, all of these are valid:

```
╔═══════════════════╗
‖col-expr row-expr‖
╚═══════════════════╝
```

```
╔═══════════════════╗
‖         row-expr‖
‖col-expr         ‖
╚═══════════════════╝
```

```
╔═══╗
```



Changed in version 6.4 of package `2d-lib`: Made scrutinee parsing more flexible.

4 2D Tabular

```
(require 2d/tabular)
```
package: 2d-lib

```
(2dtabular tabular-content)

tabular-content = tabular-row
                  ⋮
                | tabular-row
                  ⋮
                  style-cell

    tabular-row = tabular-cell ···

   tabular-cell = ╔═══════════════╗
                  ‖tabular-expr ...‖
                  ╚═══════════════╝

     style-cell = ╔═══════════════╗
                  ‖style-content ...‖
                  ╚═══════════════╝

  style-content = #:style style-expr
                | #:sep sep-expr
                | #:ignore-first-row

  style-expr : style?
  sep-expr : (or/c block? content? #f)
  tabular-expr : (or/c block? content?)
```

Constructs a `tabular` matching the given cells.

If a cell spans multiple columns, then the resulting `tabular` has `'cont` in the corresponding list element. No cells may span rows.

The `#:style` and `#:sep` arguments are just passed to `tabular`.

If the `#:ignore-first-row` keyword is provided, then the first row of the `2dtabular` expression is ignored. This can be used in case the first row of the rendered table should not have all of the columns (as `#2d` syntax requires that the first row contain a cell for each column that appears in the table).

5 2D Readtable

```
(require 2d/readtable)
```
package: 2d-lib

```
(make-readtable) → readtable?
```

Builds a `readtable?` that recognizes `#2d` and turns it into a parenthesized form as discussed in *2D Syntax*.

```
(2d-readtable-dispatch-proc char
                            port
                            source
                            line
                            column
                            position
                            /recursive
                            readtable) → any/c
  char : char?
  port : input-port?
  source : any/c
  line : (or/c exact-positive-integer? #f)
  column : (or/c exact-nonnegative-integer? #f)
  position : (or/c exact-positive-integer? #f)
  /recursive : (-> input-port? any/c (or/c readtable? #f) any/c)
  readtable : (or/c #f readtable?)
```

The function that implements `make-readtable`'s functionality. The `/recursive` function is used to handle the content in the cells.

See the docs on readtables for more information.

6 2d Lexer

```
(require 2d/lexer)
```
package: 2d-lib

```
(2d-lexer sub) → lexer/c
  sub : lexer/c
```

Constructs a lexer/c given one that handles lexing inside the cells.

7 2D Direction Chars

```
(require 2d/dir-chars)
```
package: 2d-lib

This library provides definitions of the characters that are looked for when parsing 2d syntax.

```
adjustable-chars : (listof char?)
```

These are the characters that are considered either to be part of 2d rectangle or characters that could be part of one, possibly fixed by up a DrRacket keybinding.

```
> adjustable-chars
'(#\╬ #\╩ #\╣ #\╠ #\╝ #\╚ #\║ #\+ #\| #\╦ #\╗ #\╔ #\═ #\- #\=)
```

```
double-barred-chars : (listof char?)
```

These are all of the `adjustable-chars`, except those that are regular ASCII.

```
> double-barred-chars
'(#\╬ #\╩ #\╣ #\╠ #\╝ #\╚ #\║ #\╦ #\╗ #\╔ #\═)
```

```
up-chars : (listof char?)
```

All of the 2d chars that connect to the line above.

```
> up-chars
'(#\╬ #\╩ #\╣ #\╠ #\╝ #\╚ #\║ #\+ #\|)
```

```
dn-chars : (listof char?)
```

All of the 2d chars that connect to the line below.

```
> dn-chars
'(#\╬ #\╦ #\╣ #\╠ #\╗ #\╔ #\║ #\+ #\|)
```

```
lt-chars : (listof char?)
```

All of the 2d chars that connect to the previous char.

```
> lt-chars
'(#\╬ #\╩ #\╦ #\╣ #\╝ #\╗ #\═ #\+ #\- #\=)
```

```
rt-chars : (listof char?)
```

All of the 2d chars that connect to the next char.

```
> rt-chars
'(#\╬ #\╩ #\╦ #\╠ #\╔ #\╚ #\═ #\+ #\- #\=)
```