SASE

The following text is from http://avid.cs.umass.edu/sase/index.php?page=language (slighty modified to the capabilities of Odysseus)

The SASE+ language has a high-level structure similar to SQL for ease of use. The design of the language, however, is centered on temporal event patterns that have not been sufficiently addressed in relational data processing. In particular, SASE+ has the following features:

- **Sequencing**: a sequence of events occur in specified order.
- **Negation**: an event pattern can address the non-occurrences of events.
- **Kleene closure**: a pattern can also be used to extract a finite yet unbounded number of events with a particular property.
- **Parameterized predicates**: different events are compared via value-based constraints as well as temporal constraints.
- **Sliding windows**: the entire pattern needs to occur within a specified period of time.

The overall structure of the SASE+ language is:

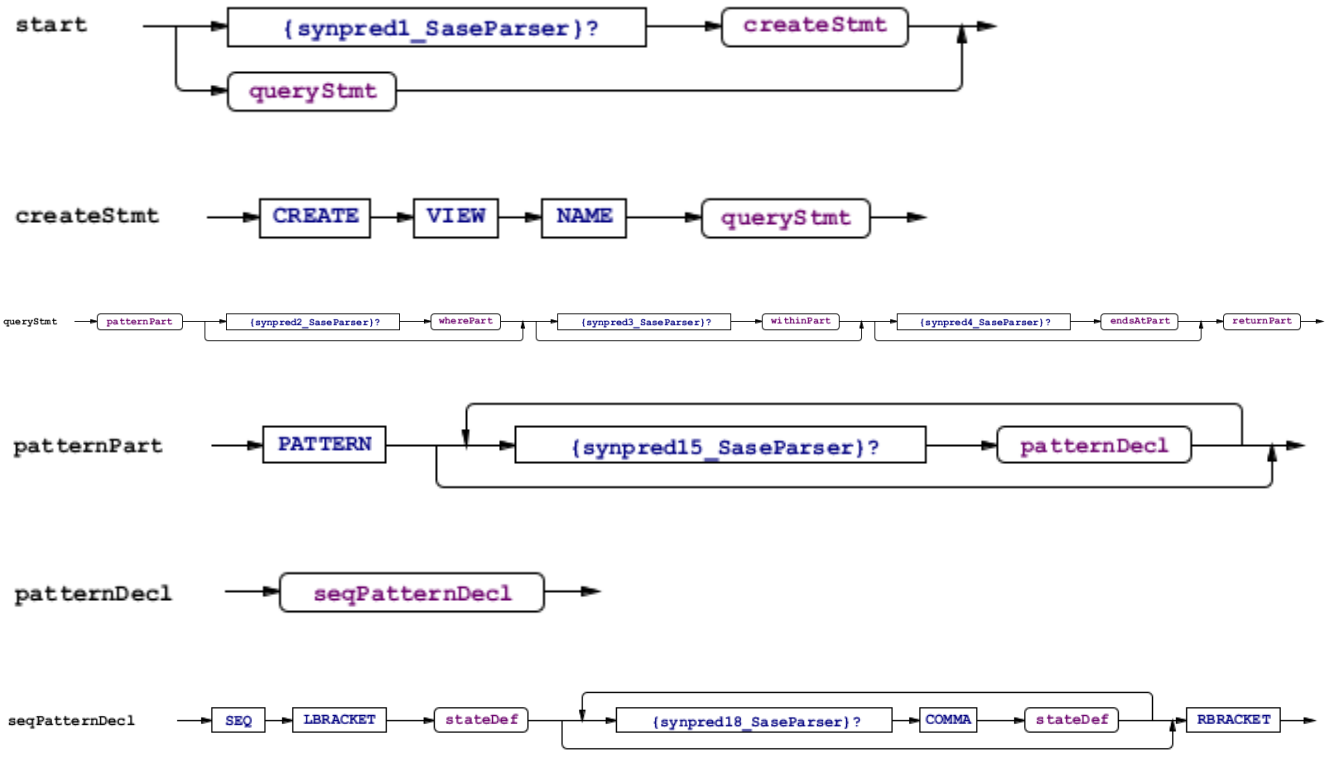
PATTERN < pattern structure >
[WHERE < pattern matching condition >]
[WITHIN < sliding window >]
[ENDS AT] < attribute with temporal condition >
[RETURN < output specification >]

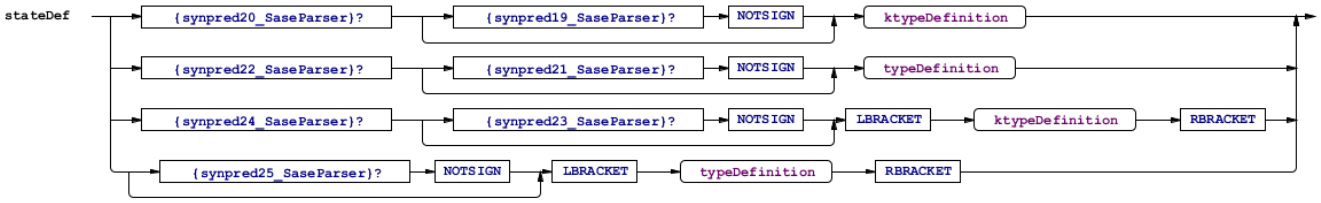
The PATTERN, WHERE and WITHIN clauses form the pattern matching block. The PATTERN clause specifies the structure of a pattern to be matched against the input stream. The WHERE clause, if present, imposes value-based constraints on the events addressed by the pattern. The WITHIN clause further specifies a sliding window over the entire pattern.

The evaluation of PATTERN, WHERE, and WITHIN clauses results in a stream of pattern matches; each consists of a unique sequence of events used to match the pattern. The HAVING clause further filters each pattern match by applying predicates on the constituent events.

Finally, the RETURN clause transforms each pattern match into a result event for output. Although expressions are possible, in Odysseus only attributes should be used in the RETURN statement

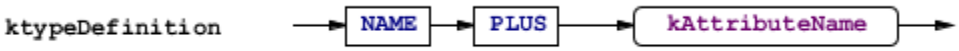
Syntax of our Implemenation

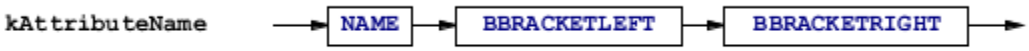


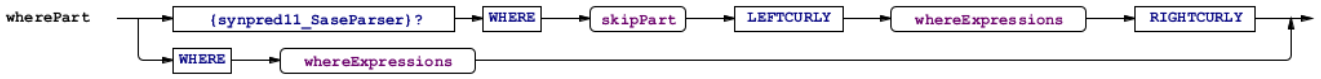

stateDef
{synpred20_SaseParser}?
{synpred19_SaseParser}?
NOTSIGN
ktypeDefinition
{synpred22_SaseParser}?
{synpred21_SaseParser}?
NOTSIGN
typeDefinition
{synpred24_SaseParser}?
{synpred23_SaseParser}?
NOTSIGN
LBRACKET
ktypeDefinition
RBRACKET
{synpred25_SaseParser}?
NOTSIGN
LBRACKET
typeDefinition
RBRACKET

typeDefinition
NAME
sAttributeName

sAttributeName
NAME

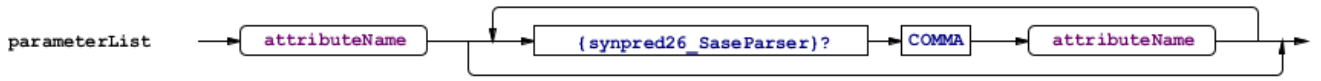

ktypeDefinition
NAME
PLUS
kAttributeName

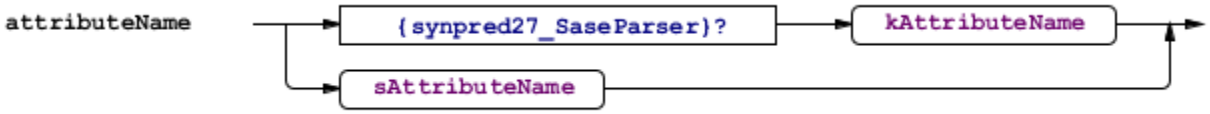

kAttributeName
NAME
BBRACKETLEFT
BBRACKETRIGHT

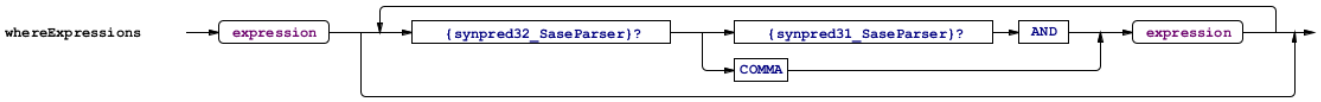

wherePart
{synpred11_SaseParser}?
WHERE
skipPart
LEFTCURLY
whereExpressions
RIGHTCURLY
WHERE
whereExpressions

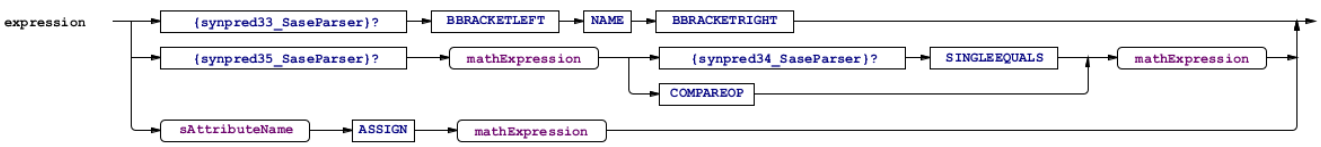
skipPart
skipMethod
LBRACKET
parameterList
RBRACKET

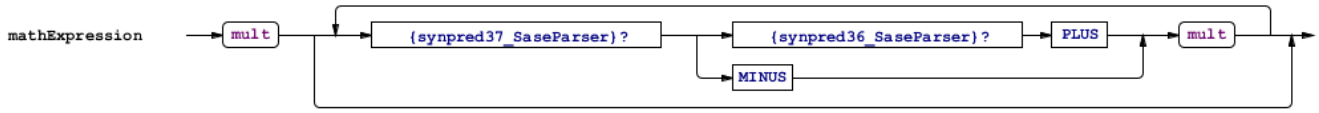
skipMethod
{PARTITION_CONTIGUITY, SKIP_TILL_ANY_MATCH..SKIP_TILL_NEXT_MATCH, STRICT_CONTIGUITY}

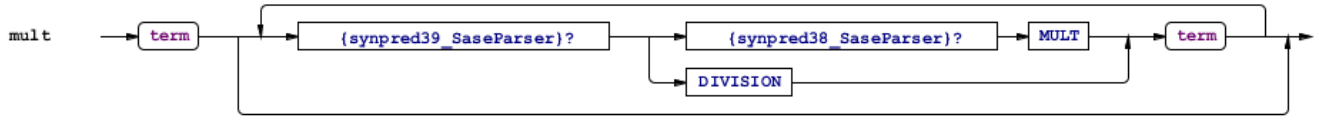

parameterList
attributeName
{synpred26_SaseParser}?
COMMA
attributeName

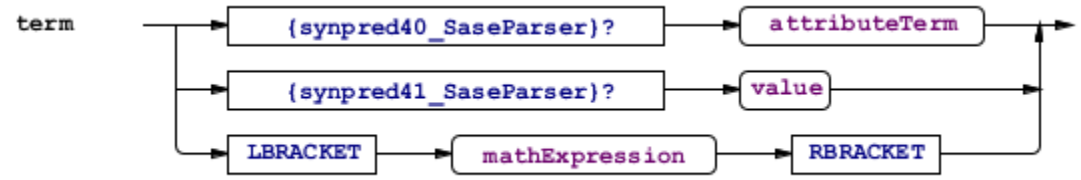

attributeName
{synpred27_SaseParser}?
kAttributeName
sAttributeName

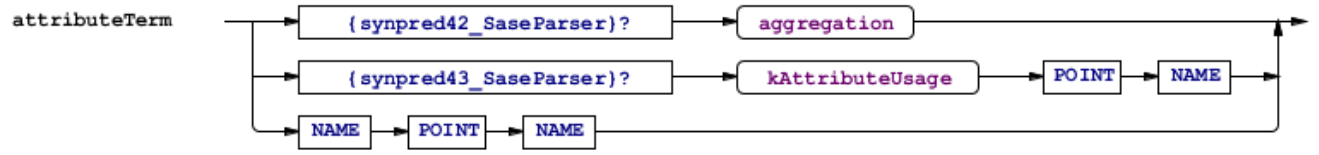

whereExpressions
expression
{synpred32_SaseParser}?
{synpred31_SaseParser}?
AND
expression
COMMA


expression
{synpred33_SaseParser}?
BBRACKETLEFT
NAME
BBRACKETRIGHT
{synpred35_SaseParser}?
mathExpression
{synpred34_SaseParser}?
SINGLEEQUALS
mathExpression
COMPAREOP
sAttributeName
ASSIGN
mathExpression


mathExpression
mult
{synpred37_SaseParser}?
{synpred36_SaseParser}?
PLUS
MINUS
mult

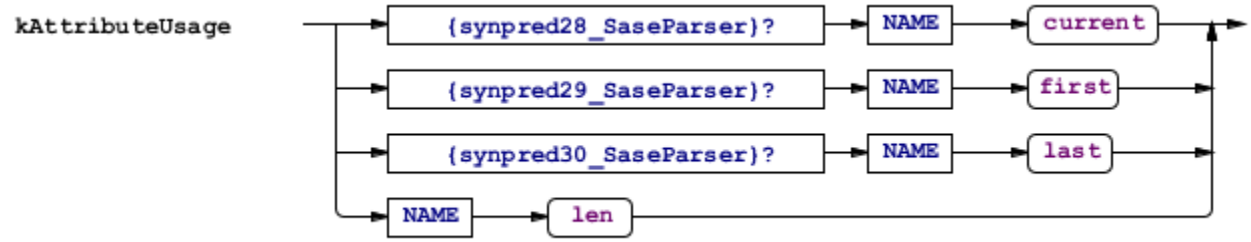

mult
term
{synpred39_SaseParser}?
{synpred38_SaseParser}?
MULT
DIVISION
term

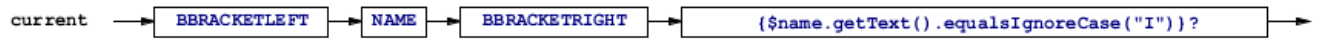

term
{synpred40_SaseParser}?
attributeTerm
{synpred41_SaseParser}?
value
LBRACKET
mathExpression
RBRACKET

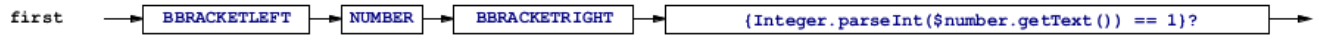

attributeTerm
{synpred42_SaseParser}?
aggregation
{synpred43_SaseParser}?
kAttributeUsage
POINT
NAME
NAME
POINT
NAME

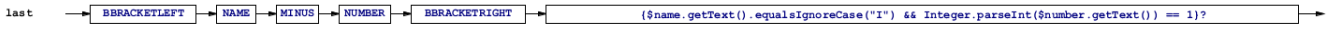
aggregation
{synpred44_SaseParser}?
aggop
LBRACKET
NAME
BBRACKETLEFT
POINT
POINT
NAME
MINUS
NUMBER
BBRACKETRIGHT
POINT
NAME
RBRACKET
{$name.getText().equalsIgnoreCase("I") && Integer.parseInt($number.getText()) == 1}?
aggop
LBRACKET
NAME
BBRACKETLEFT
BBRACKETRIGHT
{synpred45_SaseParser}?
POINT
NAME
RBRACKET

aggop
{AVG, COUNT, MAX, MIN, SUM}

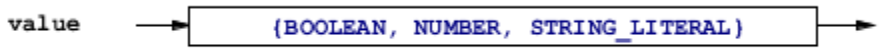

kAttributeUsage
{synpred28_SaseParser}?
NAME
current
{synpred29_SaseParser}?
NAME
first
{synpred30_SaseParser}?
NAME
last
NAME
len

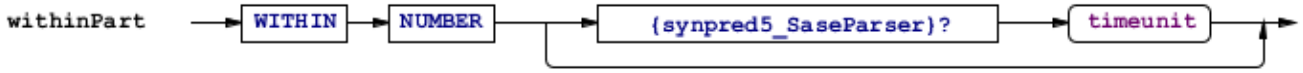

current
BBRACKETLEFT
NAME
BBRACKETRIGHT
{$name.getText().equalsIgnoreCase("I")}?

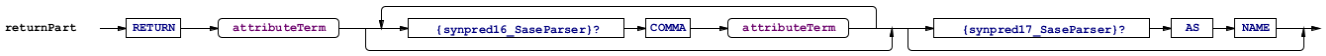

first
BBRACKETLEFT
NUMBER
BBRACKETRIGHT
{Integer.parseInt($number.getText()) == 1}?


last
BBRACKETLEFT
NAME
MINUS
NUMBER
BBRACKETRIGHT
{$name.getText().equalsIgnoreCase("I") && Integer.parseInt($number.getText()) == 1}?

len
BBRACKETLEFT
NAME
POINT
LEN
BBRACKETRIGHT







Examples

The following examples to not work all in Odysseus, currently. There is no ANY.

Examples from [http://avid.cs.umass.edu/sase/]

```
Query 1:
PATTERN        SEQ(ShelfReading x, ~ CounterReading y, ExitReading z)
WHERE        x.id = y. id AND x.id = z.id        /* equivalently, [id] */
WITHIN 16 hours
```

```
Query 2:
PATTERN        SEQ(ShelfReading x, ShelfReading y, ~ (ANY(CounterReading, ShelfReading) z) )
WHERE        [id] AND x.shelf_id  y.shelf_id AND x.shelf_id = z.shelf_id
WITHIN         1 hour
```

```
Query 3:
PATTERN        (StartLoading a,  RfidReading+ b[ ], EndLoading c)
WHERE        [loading_dock]
   AND        a.session_id = c.session_id
   AND        b[i].packaging_level = ‘pallet’
RETURN         a.session_id, count(b[ ]), b[ ].tag_id
```

```
PATTERN SEQ(MedicineTaken x, MedicineTaken y)
WHERE         [name=‘John’]
   AND        [medicine=‘Antibiotics’]
   AND        (x.amount + y.amount) > 1000
WITHIN         4 hours
```

```
PATTERN SEQ(News a, Stock+ b[ ])
WHERE   [symbol]
   AND        a.type = 'bad'
   AND        b[i].symbol = 'GOOG'
   AND b[b.LEN].volume < 80%*b[1].volume
WITHIN  4 hours
RETURN  sum(b[ ].volume)
```

```
 PATTERN        SEQ(Stock+ a[])
WHERE          [symbol]
  AND          a[1].price = 10
  AND          a[i].price > a[i-1].price
  AND          a[a.LEN].price = 20
  AND     avg(a[].volume)  a[1].volume
WITHIN  1 hour
RETURN        a[1].symbol, a[].price
```

```
 PATTERN SEQ(Stock+ a[], Stock b)
WHERE          [symbol]
  AND          a[1].volume > 1000
  AND          a[i].price > avg(a[…i-1].price))
  AND          b.volume < 80% * a[a.LEN].volume
WITHIN  1 hour
RETURN        a[1].symbol, a[].(price,volume), b.(price,volume)
```

```
 PATTERN SEQ(Scan a, ~(Scan+ b[]), Scan c)
WHERE         [object_id]
  AND         a.location = “New York”
  AND         c.location = “Amherst”
  AND         b[1].location = a.next
  AND         b[i].location = b[i-1].next
  AND         c.location = b[b.LEN].next
  AND         b.LEN  3
RETURN        c.object_id, c.courier_id
```

```
 PATTERN SEQ(Alert a, Shipment+ b[ ])
WHERE    a.type = 'contaminated'
  AND    b[1].from = a.site
  AND    b[i].from = b[i-1].to
WITHIN  3 hours
RETURN  a.type, a.site, b[ ].to
```