POSTGRES PROGRESS

ON TEMPORAL DATABASES

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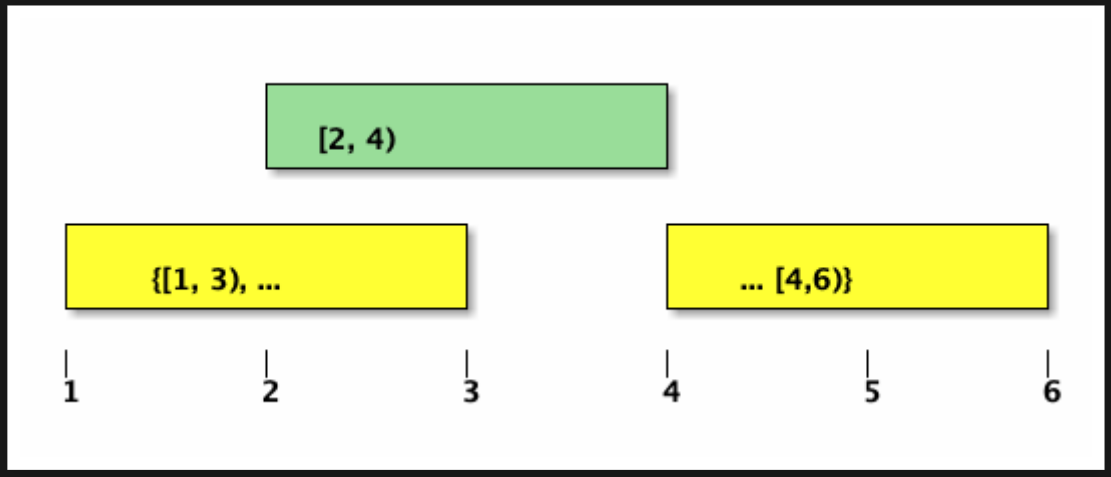
PATCHES

- Multiranges
- SQL:2011 Temporal
  - Primary Keys
  - Foreign Keys
  - `UPDATE FOR PORTION OF`
  - `DELETE FOR PORTION OF`

MULTIRANGES



MULTIRANGES

```
[1,3)
empty

{[1,3), [7,9)}
{}
```

MULTIRANGES

```
[1,3)
empty

{[1,3), [7,9)}
{}

~~{empty}~~
~~{[1,4), [4,9), [6,9)}~~
```

MULTIRANGES: CLOSURE

```
[1,4) + [7,9)        -- boom
[1,9) - [4,7)        -- boom
```

MULTIRANGES: CLOSURE

```
[1,4) + [7,9)         -- boom
[1,9) - [4,7)         -- boom

{[1,4)} + {[7,9)}     -- {[1,4), [7,9)}
{[1,9)} - {[4,7)}     -- {[1,4), [7,9)}
```

MULTIRANGES

ranges	multiranges
int4range	int4multirange
tsrange	tsmultirange
…	…
anyrange	anymultirange
textrange	textmultirange

MULTIRANGES: MEMORY

```
typedef struct
{
    char    vl_len_[4];        /* varlena header */
    Oid     multirangetypid;   /* multirange type's OID */
    uint32  rangeCount;        /* the number of ranges */

    /* RangeType structs here, which are also varlena... */
} MultirangeType;
```

MULTIRANGES: OPERATORS

```
*ranges = palloc0(*range_count * sizeof(RangeType *));

ptr = (char *) multirange;
end = ptr + VARSIZE(multirange);
ptr = (char *) MAXALIGN(multirange + 1);
i = 0;
while (ptr < end)
{
    r = (RangeType *) ptr;
    (*ranges)[i++] = r;

    ptr += MAXALIGN(VARSIZE(r));
}
```

MULTIRANGES: OPERATORS

```
= <> < <= > >=
<< >> -|-
@> <@
&> &<
&&
+ - *
```

MULTIRANGES: IDENTITIES

```
x + {} = x
x - {} = x
x * {} = {}

x @> y ≡ x + y = x
x @> {}
{} @> x ≡ x = {}

x && y ≡ x * y ≠ {} where x ≠ {} and y ≠ {}
x && {}
```

MULTIRANGES: POLYMORPHIC

poly	concrete
anyelement	integer
anyarray	integer[]
anyrange	int4range
anymultirange	int4multirange

MULTIRANGES: FUNCTIONS

```
lower(anymultirange) returns anyelement
upper(anymultirange) returns anyelement

multirange(r anyrange) returns anymultirange
range_merge(r anymultirange) returns anyrange

range_agg(r anyrange) returns anymultirange
range_intersect_agg(r anyrange) returns anymultirange
```

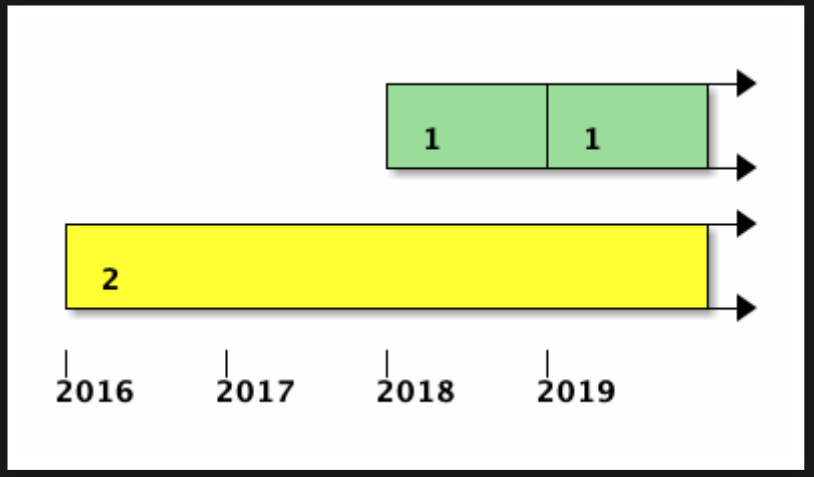
MULTIRANGES: SELECTIVITY

```
{ oid => '8073',
  oid_symbol => 'OID_RANGE_OVERLAPS_MULTIRANGE_OP',
  descr => 'overlaps', oprname => '&&',
  oprleft => 'anyrange', oprright => 'anymultirange',
  oprresult => 'bool',
  oprcom => '&&(anymultirange,anyrange)',
  oprcode => 'range_overlaps_multirange',
  oprrest => 'multirangesel',
  oprjoin => 'areajoinsel' },
```

PRIMARY KEYS

```
CREATE CONSTRAINT pk_houses
  PRIMARY KEY
  (id, valid_at WITHOUT OVERLAPS);
```

PRIMARY KEYS



PRIMARY KEYS

```
IndexElem *iparam = makeNode(IndexElem);
iparam->name = pstrdup(without_overlaps_str);
index->indexParams = lappend(index->indexParams, iparam);

opname = list_make1(makeString("&&"));
index->excludeOpNames = lappend(index->excludeOpNames, opname)
index->accessMethod = "gist";
constraint->access_method = "gist";
```

FOREIGN KEYS

```
CREATE CONSTRAINT fk_rooms_to_houses
  FOREIGN KEY
  (house_id, PERIOD valid_at)
  REFERENCES
  (id, PERIOD valid_at);
```

FOREIGN KEYS

FOREIGN KEYS

FOREIGN KEYS

```
SELECT 1
FROM   houses x
WHERE  id = $1
FOR KEY SHARE OF x;
```

FOREIGN KEYS

```
SELECT 1
FROM (
    SELECT valid_at AS r
    FROM   houses x
    WHERE  id = $1
    AND    valid_at && $2
    FOR KEY SHARE OF x
) x1
HAVING $2 <@ range_agg(x1.r);
```

FOREIGN KEYS

```
CREATE CONSTRAINT fk_rooms_to_houses
  FOREIGN KEY
  (house_id, PERIOD valid_at)
  REFERENCES
  (id, PERIOD valid_at)
```

FOREIGN KEYS

```
CREATE CONSTRAINT fk_rooms_to_houses
  FOREIGN KEY
  (house_id, PERIOD valid_at)
  REFERENCES
  (id, PERIOD valid_at)
  ON DELETE CASCADE
  ON UPDATE CASCADE;
```

UPDATE

```
UPDATE houses
  FOR PORTION OF valid_at
  FROM  '2020-01-01' TO '2021-01-01'
  SET   tax_appraisal = 250000
  WHERE id = 5;
```

DELETE

```
DELETE FROM houses
  FOR PORTION OF valid_at
  FROM  '1950-01-01' TO '1960-01-01'
  WHERE id = 7;
```

UPDATE/DELETE

- Parse
- Analyze
- Rewrite
- Plan
- Optimize
- Execute

UPDATE/DELETE: PARSE

parsenodes.h

```
typedef struct ForPortionOfClause
{
    NodeTag     type;
    char       *range_name;
    int         range_name_location;
    Node       *target_start;
    Node       *target_end;
} ForPortionOfClause;
```

UPDATE/DELETE: PARSE

```
for_portion_of_clause:
      FOR PORTION OF ColId FROM Sconst TO Sconst
        {
          ForPortionOfClause *n = makeNode(ForPortionOfClause)
          n->range_name = $4;
          n->range_name_location = @4;
          n->target_start = makeStringConst($6, @6);
          n->target_end = makeStringConst($8, @8);
          $$ = n;
        }
      | /*EMPTY*/           { $$ = NULL; }
    ;
```

UPDATE/DELETE: ANALYZE

```
FOR PORTION OF valid_at
  FROM  '2020-05-30'
  TO    '2021-01-31'
```

UPDATE/DELETE: ANALYZE

```
FuncCall *fc = makeFuncCall(
        SystemFuncName(range_type_name),
        list_make2(result->targetStart,
                   result->targetEnd),
        forPortionOf->range_name_location);
result->targetRange = transformExpr(
        pstate,
        (Node *) fc,
        EXPR_KIND_UPDATE_PORTION);
result->overlapsExpr = (Node *) makeSimpleA_Expr(
        AEXPR_OP, "&&",
        (Node *) result->range,
        (Node *) fc,
        forPortionOf->range_name_location);
```

UPDATE/DELETE: ANALYZE

```
if (stmt->forPortionOf)
{
    if (stmt->whereClause)
        whereClause = (Node *) makeBoolExpr(
            AND_EXPR,
            list_make2(qry->forPortionOf->overlapsExpr,
                       stmt->whereClause),
            -1);
    else
        whereClause = qry->forPortionOf->overlapsExpr;
}
else
    whereClause = stmt->whereClause;
```

UPDATE: ANALYZE

```
Expr *rangeSetExpr = (Expr *) makeSimpleA_Expr(
        AEXPR_OP, "*",
        (Node *) result->range,
        (Node *) fc,
        forPortionOf->range_name_location);

rangeSetExpr = (Expr *) transformExpr(
        pstate,
        (Node *) rangeSetExpr,
        EXPR_KIND_UPDATE_PORTION);
TargetEntry *tle = makeTargetEntry(
        rangeSetExpr,
        range_attno,
        range_name,
        false);
```

UPDATE/DELETE: ANALYZE

```
FOR PORTION OF valid_at
  FROM  '2020-05-30'
  TO    'Infinity'
```

UPDATE/DELETE: ANALYZE

```
=# SELECT tstzrange(NOW(), NULL)
-#      - tstzrange(NOW(), 'infinity');
```

UPDATE/DELETE: ANALYZE

```
=# SELECT tstzrange(NOW(), NULL)
-#      - tstzrange(NOW(), 'infinity');
  ?column?
------------
 [infinity,)
(1 row)
```

UPDATE/DELETE: REWRITE

UPDATE/DELETE: PLAN

UPDATE/DELETE: OPTIMIZE

UPDATE/DELETE: EXECUTE

```
// executor/modifyTableNode.c
ExprContext *econtext = GetPerTupleExprContext(estate);
econtext->ecxt_scantuple = slot;

ExprState *exprState = ExecPrepareExpr(
        (Expr *) forPortionOf->targetRange, estate);
targetRange = ExecEvalExpr(exprState, econtext, &isNull);

if (isNull) elog(ERROR, "Got a NULL FOR PORTION OF target rang
targetRangeType = DatumGetRangeTypeP(targetRange);
resultRelInfo->ri_forPortionOf->fp_targetRange = targetRangeTy
```

UPDATE/DELETE: EXECUTE

```
table_tuple_fetch_row_version(
        resultRelInfo->ri_RelationDesc,
        tupleid, SnapshotAny, oldtupleSlot);
oldRange = slot_getattr(
        oldtupleSlot,
        forPortionOf->range_attno, &isNull);
oldRangeType = DatumGetRangeTypeP(oldRange);
```

UPDATE/DELETE: EXECUTE

```
range_leftover_internal(
        typcache,
        oldRangeType,
        targetRangeType,
        &leftoverRangeType1,
        &leftoverRangeType2);
```

UPDATE/DELETE: EXECUTE

```
MinimalTuple oldtuple = ExecFetchSlotMinimalTuple(
        oldtupleSlot, NULL);
ExecForceStoreMinimalTuple(oldtuple, leftoverTuple1, false);

leftoverTuple1->tts_values[forPortionOf->range_attno - 1] =
        RangeTypePGetDatum(leftoverRangeType1);
leftoverTuple1->tts_isnull[forPortionOf->range_attno - 1] =
        false;

ExecMaterializeSlot(leftoverTuple1);
ExecInsert(mtstate, leftoverTuple1, planSlot,
           estate, node->canSetTag);
```

UPDATE/DELETE: EXECUTE

```
typedef struct TriggerData
{
    NodeTag          type;
    TriggerEvent     tg_event;
    Relation         tg_relation;
    HeapTuple        tg_trigtuple;
    HeapTuple        tg_newtuple;
    Trigger         *tg_trigger;
    TupleTableSlot  *tg_trigslot;
    TupleTableSlot  *tg_newslot;
    Tuplestorestate *tg_oldtable;
    Tuplestorestate *tg_newtable;

} TriggerData;
```

UPDATE/DELETE: EXECUTE

```
typedef struct TriggerData
{
    NodeTag          type;
    TriggerEvent     tg_event;
    Relation         tg_relation;
    HeapTuple        tg_trigtuple;
    HeapTuple        tg_newtuple;
    Trigger         *tg_trigger;
    TupleTableSlot  *tg_trigslot;
    TupleTableSlot  *tg_newslot;
    Tuplestorestate *tg_oldtable;
    Tuplestorestate *tg_newtable;
    RangeTypeP      *tg_targetportion;
} TriggerData;
```

THANKS!

https://github.com/pjungwir/pg-temporal-talk-2020