Flow Report

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Results

Our implementation successfully computes a flow of 163 on the input file, confirming the analysis of the American enemy.

We have analysed the possibilities of decreasing the capacities near Minsk. Our analysis is summaries in the following table:

Case	4W–48	4W–49	Effect on flow
1	30	20	no change
2	20	30	no change
3	20	20	no change
4	10	30	no change
5	30	10	no change
6	10	10	-20

In cases 3-6, the new bottleneck becomes the blue line found on the last page. The edges cut are:

47–46, 48–4W, 49–4W, 49–5, 50–7, 51–7, 51–52, 51–R, H–R

In cases 3-5, the flow is still 163, but our algorithm chooses the new cut. The comrade from Minsk is advised to choose case 6, since it is the only one that reduces the overall flow.

Implementation details

We use a straightforward implementation of Ford-Fulkerson flow algorithm as described in Bronstein, *Foundations of Algorithms*, chap. 6. We use Depth-first-search to find an augmenting path.

The running time is $O(e * f)$, where f is the maximum flow.

We have only implemented the residual graph, which the input is parsed directly to. Each residual edge is directed and created together with a counterpart. When the flow through an edge is updated, it updates its counterpart by the difference. You can then get the original capacity by just summing the flows of the edge and its counterpart. Our datatype for edge is this:

```
class RestDiEdge
{
  Vertex from, to;
```

```
  RestDiEdge counterpart;
  int value;

  void setRestValue(int);
  void setValue(int);
  int getCapacity();
  int getValue();
}
```

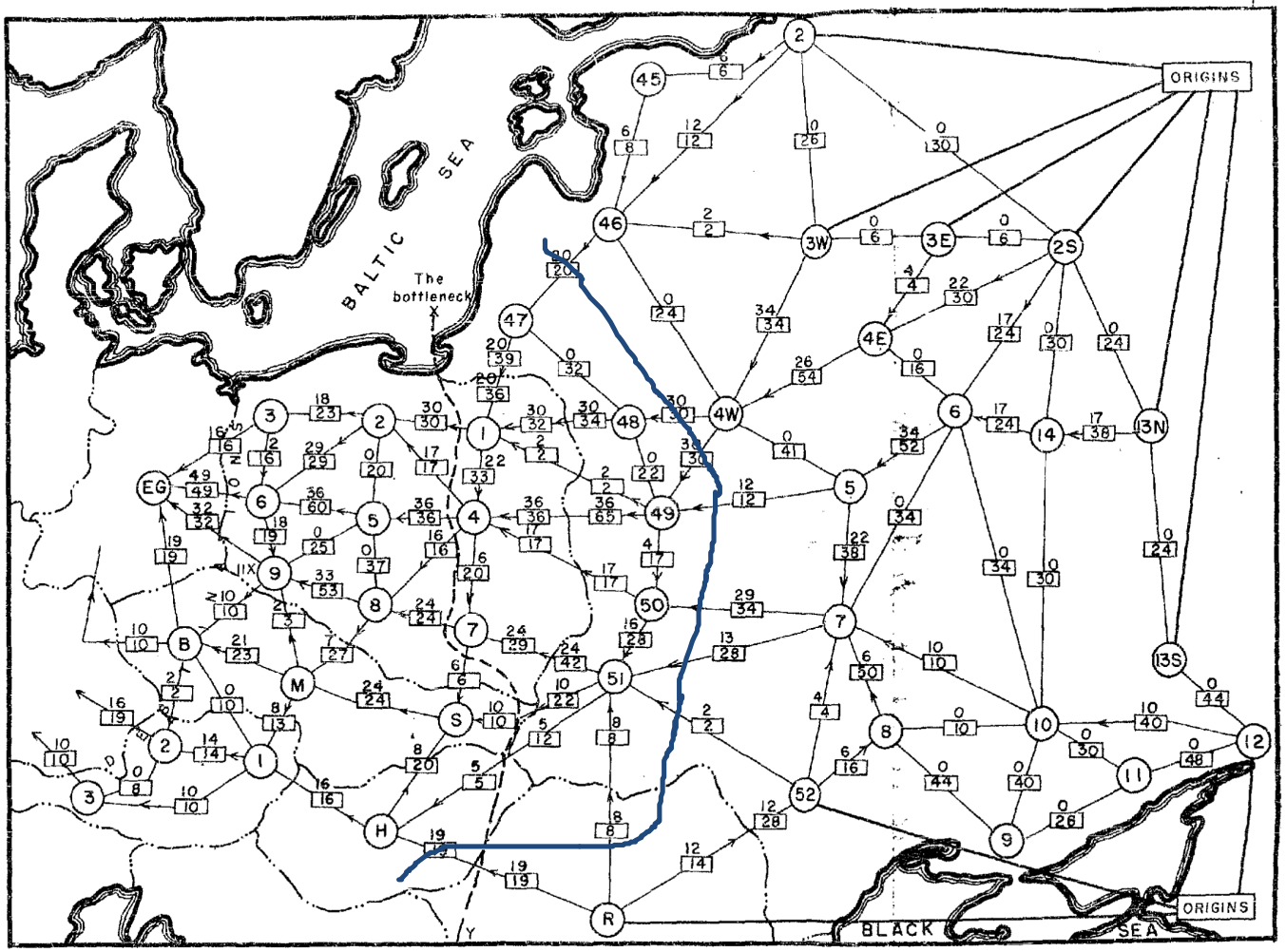

Fig. 7 — Traffic pattern: entire network available

Legend:

—·—·— International boundary

(8) Railway operating division

9 / 12 Capacity: 12 each way per day. Required flow of 9 per day toward destinations (in direction of arrow) with equivalent number of returning trains in opposite direction

All capacities in trains / 1000's of tons } each way per day

Origins: Divisions 2, 3W, 3E, 2S, 13N, 13S, 12, 52 (USSR), and Roumania

Destinations: Divisions 3, 6, 9 (Poland); B (Czechoslovakia); and 2, 3 (Austria)

Alternative destinations: Germany or East Germany

Note IIX at Division 9, Poland

Assumption:

Entire network available for east–west traffic (no allowance for civilian or economic traffic)

Results:

(a) 163,000 tons per day can be delivered from points of origin to destinations.
(b) 147,000 tons per day can be delivered without using Austrian lines.
(c) 152,000 tons per day can be delivered into Germany by all lines.
(d) 126,000 tons per day can be delivered into East Germany without using Austrian lines.