

Generation in the Grammar of Translations represents a depth-first search procedure. Thus, transition-ordering constraints are established. If one transition is judged to be superior to its siblings it should be searched first. The transitions with low scores should be pruned. These scores are based on the notion of the ordering of Zones. Function $QUAL(Z)$, a *quality* of Zones, is the key component of this ordering. $QUAL(Z)$ is based on the concept of *quality* of trajectories given by function $qual_s(t)$.

$$QUAL(Z) = qual_s(t),$$

where t is the main trajectory of Zone Z . The algorithm for computation of function of quality is based on the concept of *optimal exchange* of elements of a Complex System.

Consider the main trajectory of a Zone. Consider a stop, location x , along this trajectory. Assume that the main element p_0 from P_1 arrived at this location. Now, consider a set of all the elements that dominate x , $DOMINATE(p_0, x) = \{p \mid ON(p) = z \in R_p(z, x)\}$. These are the elements located one step away of the location x . Consider all the possible exchanges of the elements from $DOMINATE(p_0, x)$ on x . An exchange lasts until all the legal operators $TRANSITION(p, z, x)$ are exhausted. The terminal state of this exchange can be evaluated by the function ex , an algebraic sum of the values of elements p that have been withdrawn:

$$ex(p_0, x, state) = - \sum_{p \in P_1} val(p) + \sum_{p \in P_2} val(p)$$

Employing this evaluation function and minimax algorithm on all possible exchanges on x we can find the optimal exchange. If the optimal value of $ex(p_0, x, state) > 0$ then this optimal exchange is considered to be in favor of the side P_1 and this location x along main trajectory of p_0 is called *open*; otherwise – the location is called *closed*. (Similar exchanges can be considered for the main trajectories of the elements p_0 from P_2 .)

Let us check all the locations of the main trajectory except the beginning. Based on this check we can count the number of open and closed locations along the trajectory. A trajectory is called open if all these locations are *open*, otherwise – it is called *closed*. Closed trajectories belong to subclasses with one closed location, two locations, and more. Consider an open main trajectory and a retreat Zone for its target (Section 2.5). Assume that all the locations for retreat are closed, then the target is called *vulnerable* and the main trajectory in the attack Zone is called a

trajectory with *vulnerable* target. This approach allows to order main trajectories and respective Zones beginning from the trajectories with vulnerable target at the top of the list, then – open (non-vulnerable), then – with one closed location, two, and more. Similar ordering with the exception of vulnerability can be done to any trajectory of a Zone. This order can be reflected by the function of *constant quality* of a trajectory $qual_C(t)$. It is based on the constant values val of the elements of a Complex System. However, the actual values of elements with respect to the rest of a System may change when Complex System moves from state to state. These changed values may alter the order of trajectories and Zones and their respective qualities.

The concept of changing values can be formalized based on the function of constant quality of trajectories $qual_C(t)$. These changing values are called *situational values*. Consider a main trajectory t of an element p_0 of a Zone and all the elements of the sets $DOMINATE(p_0, x)$ for all locations x along this trajectory as well as elements dominating the locations of a retreat Zone. Consider subsets $OPT(p_0, x)$ of these sets that influence the values of optimal exchanges $ex(p_0, x, state)$ for all the locations x introduced above. To construct these subsets OPT we exclude elements from the exchange (except p_0) one at a time by eliminating it from the current state. If the result of optimal exchange $ex(p_0, x, state)$ without an element is different, this element belongs to $OPT(p_0, x)$. Once we constructed all the sets OPT related to the main trajectory t , we can mark these elements with the values of function $qual_C(t)$. It is called a *spot*. By doing so for all the main trajectories, we will mark all the elements that influence optimal exchanges. A sum of several greatest spots for every element is a *situational value* of this element. It shows the impact of an element on the quality of trajectories of Zones at a certain state. The greater the value of an element the more influence it has, and therefore the more valuable this element is.

The situational values of elements can be used to calculate new situational qualities of trajectories $qual_S(t)$. We should recalculate optimal exchanges and open and closed locations along the trajectories. Function $qual_S(t)$ is used in defining the ordering of trajectories and Zones $ORDER(Z)$.

The algorithm considered above is explained in Fig. 12.1. Two Zones with main trajectories 1–2 and 4–5 are shown in Fig. 12.1.a. The size of the circles is proportional to the constant values of respective elements. The constant qualities $qual_C(t)$ of trajectories are reflected in Fig. 12.1.b via thickness of lines. Indeed, the main trajectory 1–2 is of lower quality than trajectory 4–5. On the next stage shown in Fig. 12.1.c the situational values of elements have been calculated. As a result, the value of element 2 is the greatest, the next – element 4, then 5, 3, 1. These respective situational values differ from the constant values shown in Fig.

12.1a and 12.1.b. Based on the situational values of elements, the situational qualities of trajectories are calculated. They are shown in Fig. 12.1.d (reflected via thickness of lines). It turns out that situational qualities are different from the constant qualities: the quality $qual_s(t)$ of trajectory 1–2 is greater than the quality of trajectory 4–5 in contrary with constant qualities reflected in Fig. 12.1.b.

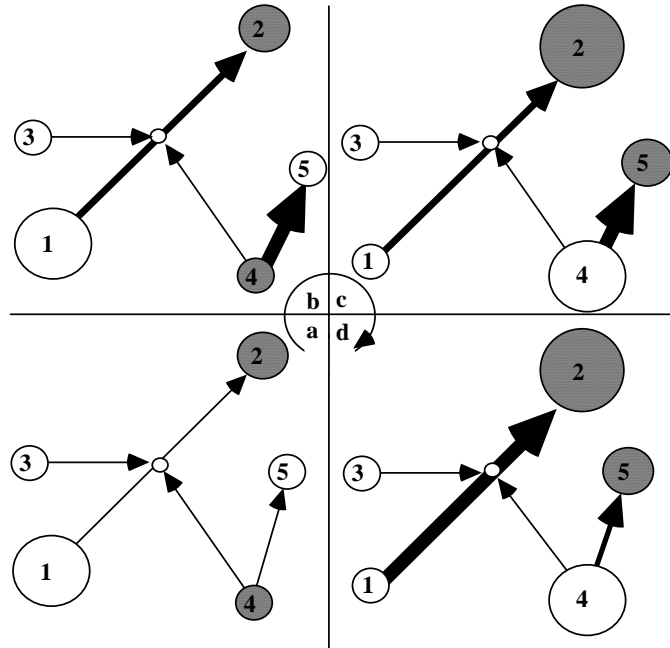
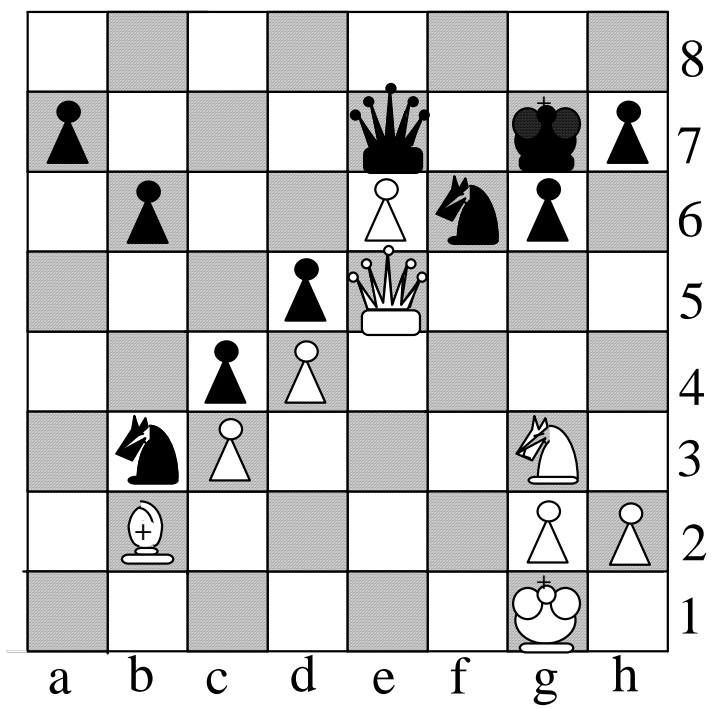


Figure 12.1. Computation of the quality of trajectories

Another approach to computation of quality of Zones $QUAL(Z)$ is related to the *search* for an optimal variant of motion within each Zone. At first, the search is done employing constant values of elements. Then, the situational values of elements are calculated by eliminating elements one at a time and redoing the search without them. If the optimal result is different an element that was eliminated should receive a *spot*. A sum of spots from different Zones for an element is a *situational value* of this element. An optimal result of another search in a Zone employing the situational values of elements is a *quality* of a Zone $QUAL(Z)$.

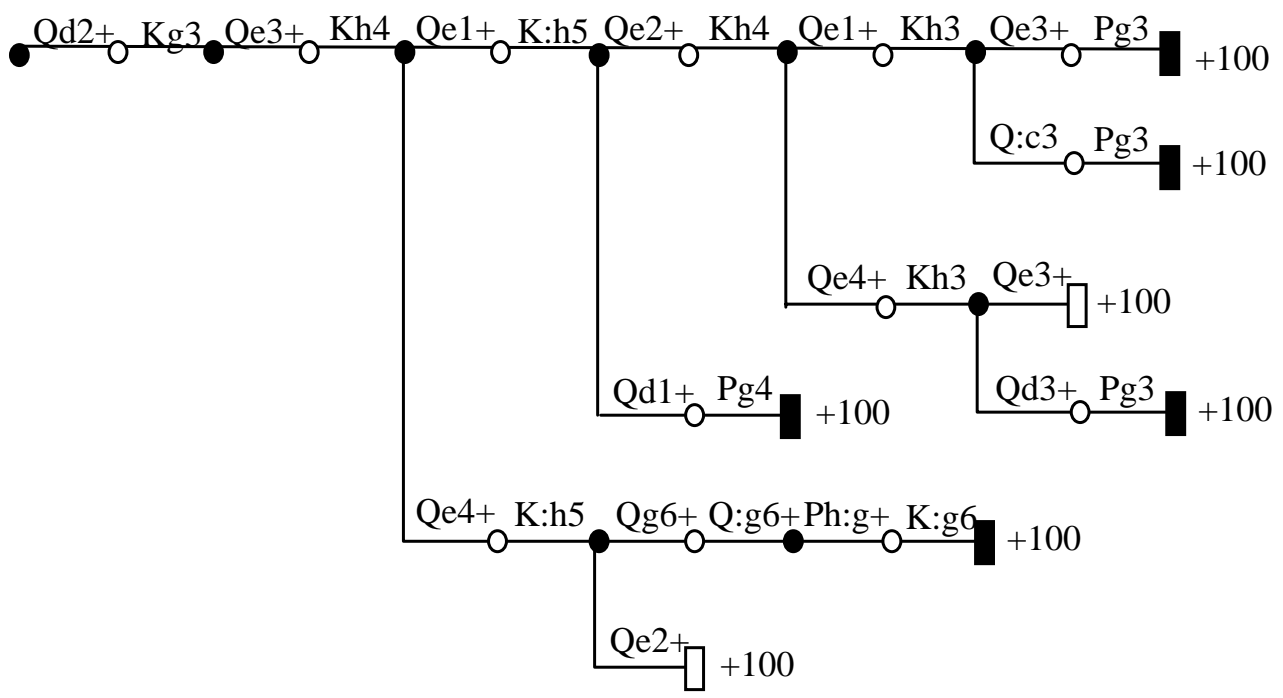
Botvinnik-Capablanca, 1938.

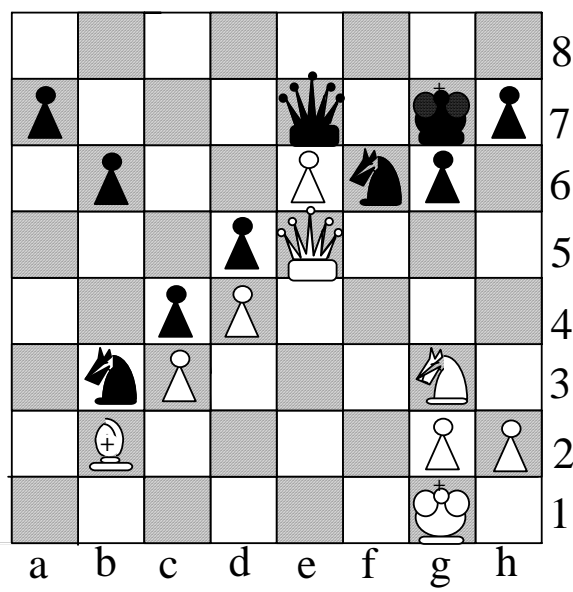
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(continued on the next page)



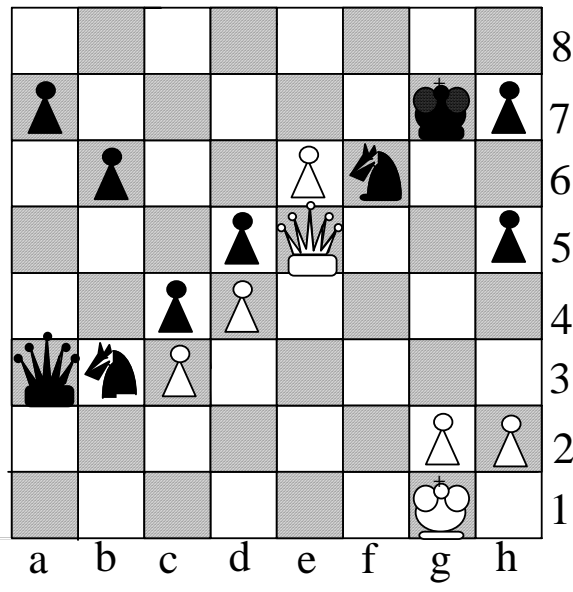
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Branching Factor	1.05

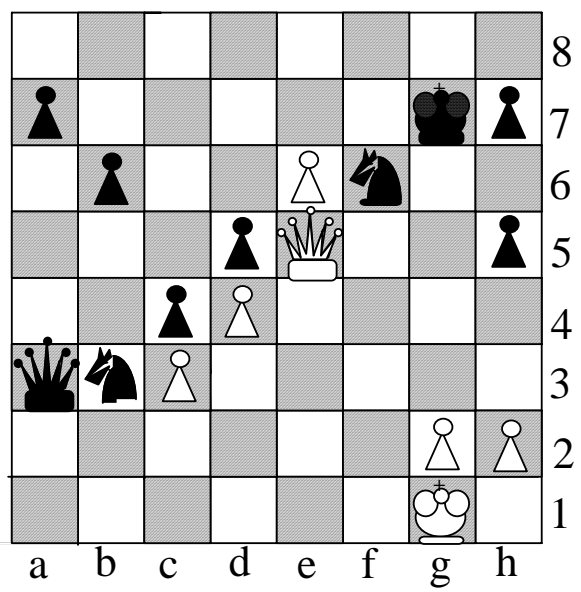
White to move.



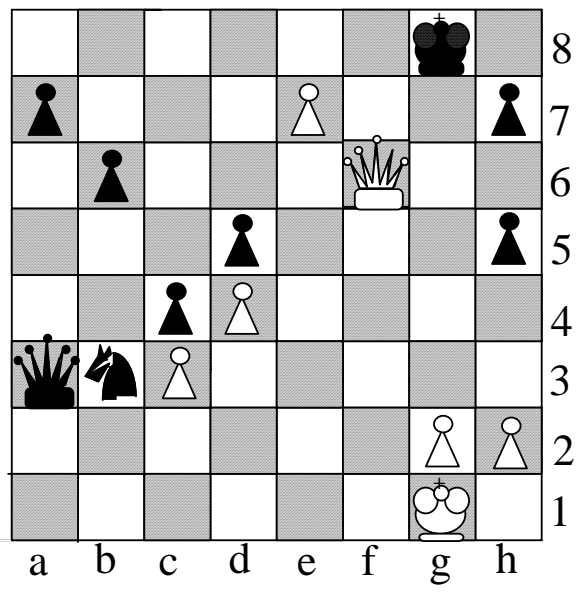


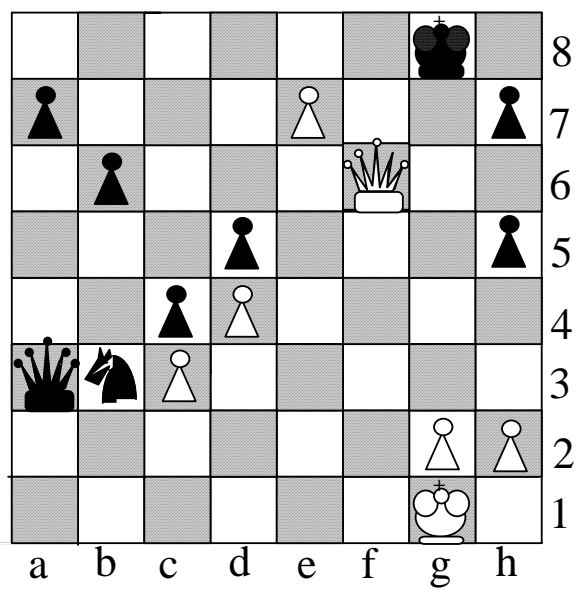
Ba3 Q:a3 Nh5+ P:h5



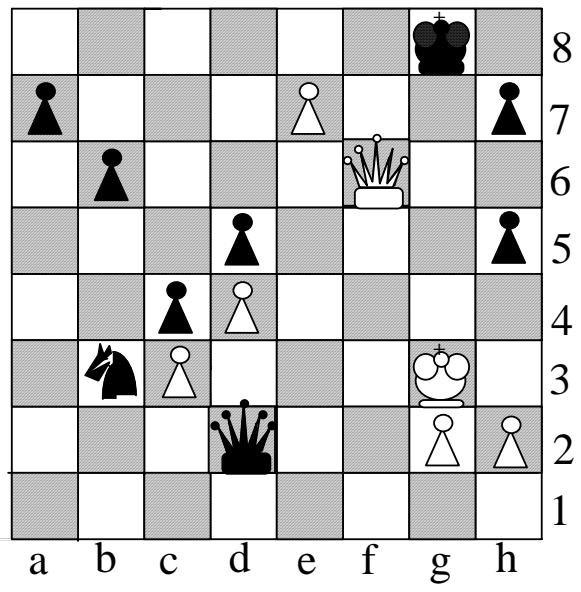


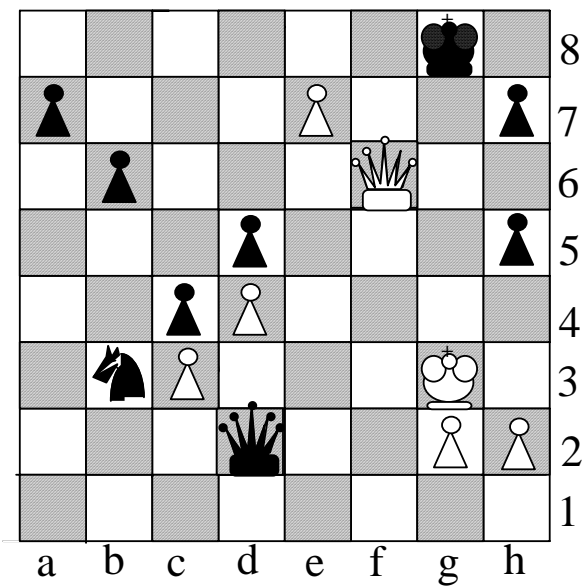
○ Qg5+ ● Kh8 ○ Q:f5+ ● Kg8 ○ e7 ●





● Qc1+ ○ Kf2 ● Qd2+ ○ Kg3 ●





● Qe3+ ○ Kh4 ● Qe1+ ○ K:h5 ●

